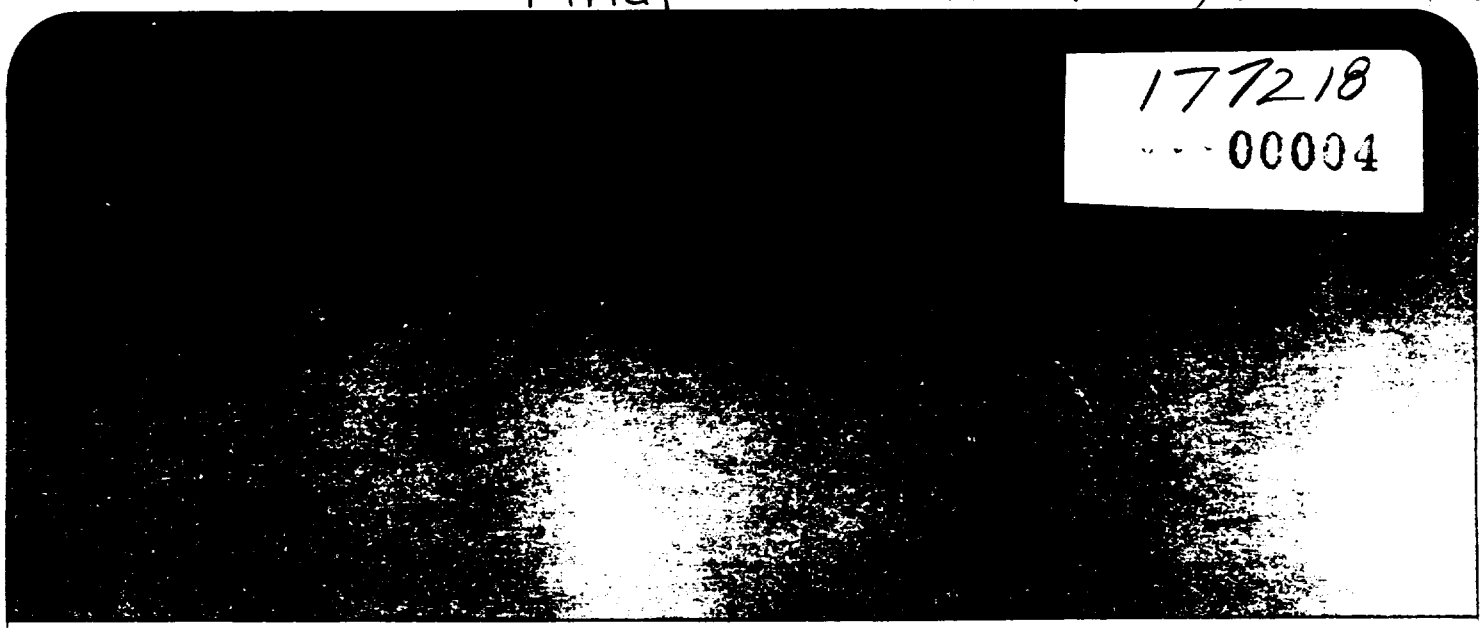
Final

Final Version, as amended by inse



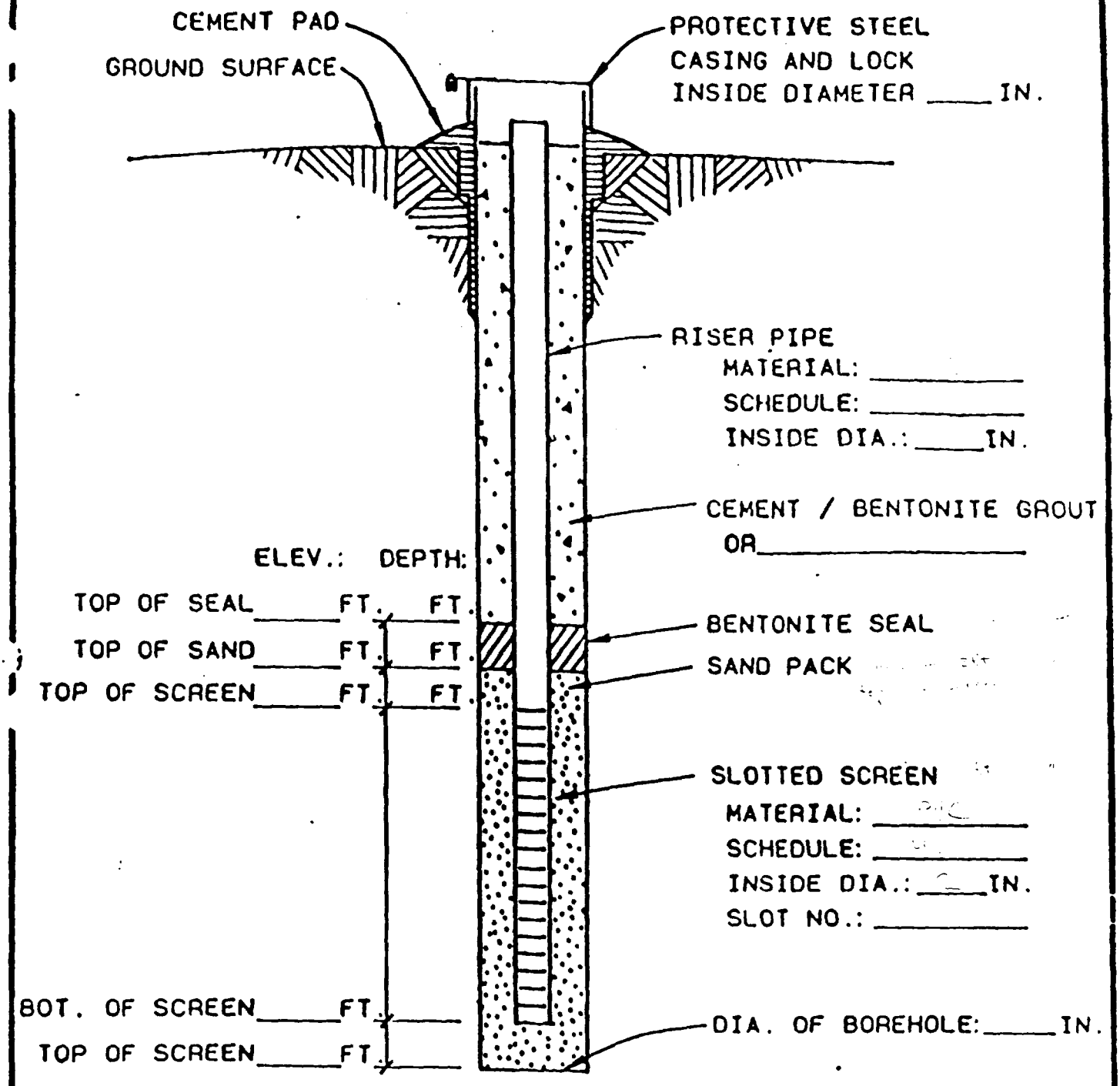
Remedial Investigation/ Feasibility Study

Granite City Site
Granite City, Illinois

NL Industries
Hightstown, New Jersey

May 1986

O'BRIEN & GERE



TYPICAL OVERBURDEN MONITORING WELL

N.T.S.

GRANITE CITY SITE
GROUND WATER INVESTIGATION
PROPOSED ADDITIONAL ACTIVITIES SCHEDULE

Activity	Duration (days)[1]
Well Specifications	10
Regulatory Approval	30
Property Access	30
Well Installation and Development	10
Well Sampling - Round 1	10
Sample Analysis - Round 1	45
Sample Delay	15
Well Sampling - Round 2	10
Sample Analysis - Round 2	45
Report Preparation	30

(1) Business Days

orginal - final version
7/30/86

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN (QAPP)

GRANITE CITY SITE

GRANITE CITY, ILLINOIS

APPROVALS:

USEPA REGION V
REMEDIAL PROJECT MANAGER
Brad W Bradley
Date: 7/30/86

USEPA REGION V
QUALITY ASSURANCE OFFICER
Amos N. Adams Jr.
Date: 7/22/86

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY
REMEDIAL PROJECT MANAGER
Kenneth M. Miller
Date: 7-14-86

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY
QUALITY ASSURANCE OFFICER
Bina Shah Flecle
Date: 7-14-86

O'BRIEN & GERE ENGINEERS, INC.
PROJECT OFFICER
C B Murphy Jr
Date: 6/26/86

OBG LABORATORIES, INC.
QUALITY ASSURANCE OFFICER
David C.
Date: 6/26/86

PREPARED BY:

O'BRIEN & GERE ENGINEERS, INC.
1304 BUCKLEY ROAD
SYRACUSE, NEW YORK 13221

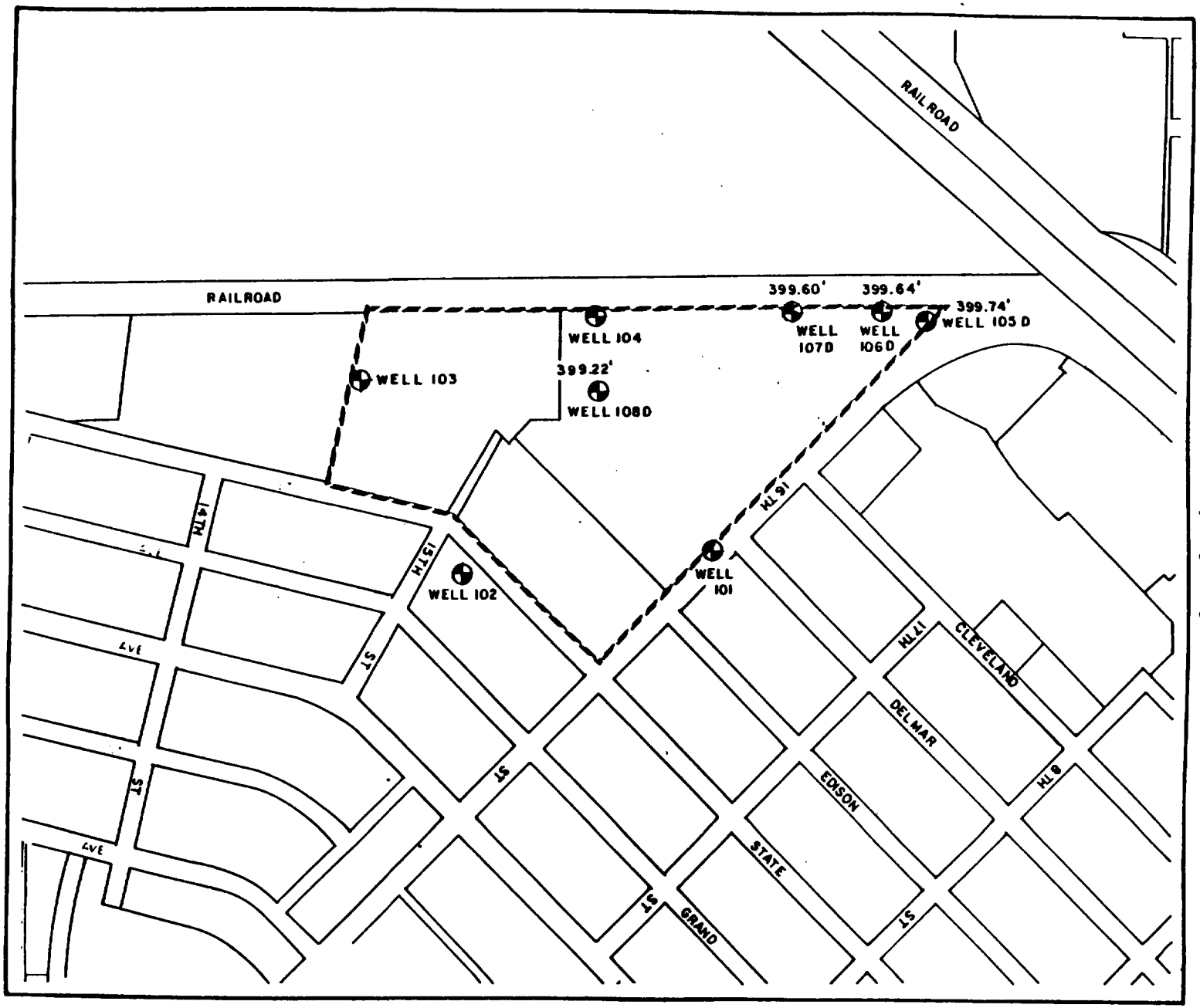
2844.012.103

GROUND WATER MONITOR WELL DATA
NATIONAL LEAD INDUSTRIES
GRANITE CITY, ILLINOIS
TABLE 1

Well Number	Elevation of Top of Steel Casing	Elevation of Top of PVC Casing	Elevation of Ground Level	Screened Interval	Elevation of Water Table 11/16/82	Elevation of Water Table 1/26/83	Elevation of Water Table 2/28/83	Elevation of Water Table 6/29/83	Elevation of Water Table 8/01/83	Elevation of Water Table 8/24/83	Elevation of Water Table 10/11/83	Elevation of Water Table 1/6/87	Elevation of Water Table 3/13/87	Elevation of Water Table 4/8/87
101	421.9 ft.	421.52 ft.	418.9 ft.	407.0 - 397.0 ft.	399.3 ft.	402.8 ft.	402.9 ft.	404.2 ft.	-	402.7 ft.	401.90 ft.	401.86 ft.	401.32 ft.	401.15 ft.
102	417.3 ft.	416.88 ft.	414.0 ft.	402.0 - 392.0 ft.	399.2 ft.	401.7 ft.	401.6 ft.	404.2 ft.	-	399.7 ft.	398.7 ft.	399.83 ft.	398.76 ft.	398.55 ft.
103	417.6 ft.	417.26 ft.	414.6 ft.	403.0 - 393.0 ft.	398.8 ft.	402.1 ft.	401.9 ft.	402.7 ft.	-	400.4 ft.	399.2 ft.	400.96 ft.	399.10 ft.	398.93 ft.
104	420.8 ft.	420.25 ft.	417.8 ft.	406.0 - 396.0 ft.	397.7 ft.	400.5 ft.	400.6 ft.	401.7 ft.	-	400.1 ft.	399.0 ft.	398.97 ft.	398.13 ft.	397.92 ft.
105-S	N/A	428.87 ft.	425.9 ft.	405.0 - 400.0 ft	-	-	-	-	402.07 ft.	401.29 ft.	399.97 ft.	401.27 ft.	DRY	DRY
105-D	N/A	428.99 ft.	426.2 ft.	396.0 - 391.0 ft.	-	-	-	-	402.09 ft.	401.30 ft.	399.89 ft.	401.24 ft.	394.99 ft.	399.74 ft.
106-S	N/A	424.00 ft.	421.1 ft.	406.0 - 401.0 ft.	-	-	-	-	402.00 ft.	Dry	Dry	401.04 ft.	DRY	DRY
106-D	N/A	423.93 ft.	421.8 ft.	392.0 - 387.0 ft.	-	-	-	-	402.03 ft.	401.15 ft.	399.83 ft.	401.16 ft.	399.93 ft.	399.64 ft.
107-S	N/A	421.07 ft.	419.0 ft.	402.0 - 397.0 ft.	-	-	-	-	404.77 ft.	404.58 ft.	403.27 ft.	403.34 ft.	402.93 ft.	402.07 ft.
107-D	N/A	421.97 ft.	419.0 ft.	389.0 - 384.0 ft.	-	-	-	-	402.97 ft.	400.99 ft.	399.67 ft.	400.94 ft.	398.91 ft.	399.60 ft.
108-S	N/A	422.88 ft.	419.9 ft.	405.9 - 400.0 ft.	-	-	-	-	402.08 ft.	401.10 ft.	399.98 ft.	400.72 ft.	DRY	DRY
108-D	N/A	421.88 ft.	420.0 ft.	390.0 - 385.0 ft.	-	-	-	-	401.58 ft.	400.63 ft.	399.28 ft.	400.58 ft.	399.51 ft.	399.22 ft.

NOTES: D denotes deep well
S denotes shallow well

FIGURE



N

NL INDUSTRIES
GRANITE CITY SITE
GRANITE CITY, ILLINOIS

GROUNDWATER ELEVATION MAP

(DEEP WELLS)
4/8/87

LEGEND

401.15'
WELL 101 — GROUNDWATER MONITOR WELL & GROUNDWATER ELEVATIONS FOR DEEP WELLS (4/8/87).

SITE PERIMETER

SCALE

300 0 300
FEET

O'BRIEN & GERE

TABLE C-1

QA/QC OBJECTIVES FOR FILTERED AQUEOUS SAMPLES AND UNFILTERED GROUNDWATER FOR LEAD

Parameter	Method[1]		Detection Limit (ppb)	Average Accuracy	Precision	Completeness
Antimony	204.2	Furnace *	20	85-115%	20%	100%
Arsenic	206.2	Furnace	5	85-115%	20%	100%
Cadmium	213.2	Furnace *	1	85-115%	10%	100%
Chromium	218.2	Furnace *	5	85-115%	10%	100%
Copper	220.2	Furnace *	10	85-115%	10%	100%
Iron	236.1	Flame	100	85-115%	10%	100%
Lead**	239.2	Furnace *	5	85-115%	10%	100%
Mercury	245.1	Cold Vapor	.2	85-115%	20%	100%
Manganese	243.1	Flame	25	85-115%	10%	100%
Nickel	249.2	Furnace *	10	85-115%	10%	100%
Selenium	270.2	Furnace	2	85-115%	20%	100%
Silver	272.2	Furnace *	5	85-115%	10%	100%
Zinc	289.1	Flame	20	85-115%	10%	100%
Barium	208.1	Flame	1,000	85-115%	10%	100%
Sulfate	375.3	Gravimetric	10,000	85-115%	20%	100%
TDS	160.1	Gravimetric	10,000	85-115%	20%	100%

Quality Control Measures

- Analyze one Field Blank - no positives.
- Analyze one Method Blank - no positives.
- Analyze one matrix spike for every 10 samples- acceptable recoveries 75-125%.
- Analyze one duplicate for every 20 samples.

- Furnace methods
  - Lanthanum nitrate added for sulfate suppression in analysis of lead.
  - All solutions will be quantified by method standard additions as appropriate, consistent with Metals pages 1, 8, 9, and 12 of Reference 1.

- Flame methods
  - Potassium chloride added for barium analysis - nitrous oxide flame.

* Either appropriate flame or furnace methods are acceptable; however, if flame methods are utilized and concentrations are less than 3-5 times the corresponding flame detection limits, the results will be verified by utilization of furnace methods.

** All unfiltered groundwater will be digested using Method 3020. Any spikes will be matrix spikes prior to digestion. All final solutions will be quantified by method of standard additions as appropriate consitent with Metals pages 1, 8, 9, and 12 of Reference 1.

[1] USEPA, "Methods for Chemical Analyses of Water and Wastes," March, 1979.

TABLE C-2

QA/QC OBJECTIVES FOR SOIL, SEDIMENT, SOLID AND UNFILTERED AQUEOUS SAMPLES

Parameter	Method[1]		Digestion[2]	Detection Limit in final Digest (ug/l)	Average Accuracy	Precision	Completeness
Antimony	204.2	Furnace	3050	20	75-125%	25%	90%
Arsenic	206.2	Furnace	3050	5	75-125%	25%	90%
Barium	208.1	Flame	3050	200	75-125%	25%	90%
Cadmium	213.1	Flame	3050	20	75-125%	25%	90%
Chromium	218.1	Flame	3050	50	75-125%	25%	90%
Copper	220.1	Flame	3050	50	75-125%	25%	90%
Iron	236.1	Flame	3050	50	75-125%	25%	90%
Lead	239.1	Flame	3050*	200	75-125%	25%	90%
Manganese	243.1	Flame	3050	25	75-125%	25%	90%
Mercury	245.1	Cold Vapor	7471	.2	75-125%	25%	90%
Nickel	249.1	Flame	3050	100	75-125%	25%	90%
Selenium	270.2	Furnace	3050	20	75-125%	25%	90%
Silver	272.1	Flame	3050	50	75-125%	25%	90%
Zinc	289.1	Flame	3050	50	75-125%	25%	90%

Quality Control Measures

- Analyze two solid reference materials from EMSL - Cincinnati and/or National Bureau of Stds.
- Spike standard solution into distilled water and proceed through Digestion Method 3050.
- Spike two digestates with all metals of interest and analyze for recoveries - acceptable recoveries 65-135%.
- Analyze one Field blank - no positives.
- Analyze one Method blank - no positives.
- If recoveries are outside acceptable limit, method of standard additions will be used for furnace methods.

[1] USEPA, "Methods for Chemical Analyses of Water and Wastes," March, 1979.

[2] USEPA, "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods," SW-846, 1984.

* Digested by Method 3010 for surface run-off lead analyses.

TABLE C-2

QA/QC OBJECTIVES FOR SOIL, SEDIMENT, SOLID AND UNFILTERED AQUEOUS SAMPLES (Continued)

- Digestion
  - Samples will be subjected to Method 3050 for digestion.
  - Hydrochloric acid final reflux for analysis of Sb, Ag, Cd, Cr, Cu, Pb, Ni, Zn.
  - Nitric acid final reflux for analysis of As, Se, Fe, Mn, Ba.
- Analysis
  - Barium - Potassium chloride addition - nitrous oxide flame.
  - Chromium - nitrous oxide flame.
  - If silver results are greater than 1 ppm will require analysis of nitric acid reflux solution.
  - Lead in soil analysis will spike at 10 - 30 mg/l (in final digest) as a matrix spike prior to sample digestion.

- final changes excluding QAPP - changes described in memo - pages were inserted/deleted in document

O'BRIEN & GERE

June 24, 1986

Director, Waste Management Division
USEPA, Region V
Attn: Mr. Brad Bradley (5HE-12)
230 S. Dearborn Street
Chicago, IL 60604

Director, ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY
Attn: Mr. Ken M. Miller
2200 Churchill Road
Springfield, IL 62706

Re: NL Granite City Site

File: 2844.012

Gentlemen:

Pursuant to recent communication between NL Industries, Inc. (NL), U.S. Environmental Protection Agency (USEPA), and Illinois Environmental Protection Agency (IEPA), minor revisions to the subject Remedial Investigation Work Plan (RIWP) and Quality Assurance Project Plan (QAPP) have resulted. Specifically, these modifications are as follows:

1. RIWP, p.16, Section 3.04 - delete last sentence;
2. RIWP, Table 2 - modifications to analytical program;
3. RIWP, Figure 6 - delete;
4. QAPP (Appendix C), Cover Page - include IEPA signatures; and
5. Sampling Plan (Appendix D), Table D-2- modifications.

Enclosed are copies of items 1, 2, 4 and 5 above incorporating the revisions stated. Please replace the pages in the May, 1986 submittal with the appropriate pages enclosed, and remove Figure 6 of the RIWP.

Upon your approval of the QAPP, please obtain the required signatures on the enclosed Cover Page of the QAPP, and forward one copy of the signed Cover Page to Mr. Stephen W. Holt of NL Industries, Inc.

If you have any questions regarding this matter, please contact us.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Frank D. Hale
Research Manager

FDH:jld:D15:08

cc: Mr. S.W. Holt - NL
Mr. D.M. Crawford-OBG

- NL Version of QAPP changes
- changes described in memo
- changed pages were inserted in document

O'BRIEN & GERE

July 30, 1986

RECEIVED
AUG 4 1986
U.S. EPA, REGION V
WASTE MANAGEMENT DIVISION
HAZARDOUS WASTE ENFORCEMENT BRANCH

Mr. Stephen W. Holt
Environmental Control Department
NL INDUSTRIES, INC.
P.O. Box 1090
Wyckoff Mills Road
Hightstown, NJ 08520

Director, Waste Management Division
USEPA, Region V
Attn: Mr. Brad Bradley (5 HE-12)
230 South Dearborn Street
Chicago, IL 60604

Director, Illinois Environmental
Protection Agency
Attn: Mr. Ken M. Miller
2200 Churchill Road
Springfield, IL 62706

Re: NL Granite City Site

File: 2844.012

Gentlemen:

Recent communication between NL Industries, Inc. and the U.S. Environmental Protection Agency has resulted in several revisions to Tables C-1 and C-2 of the Quality Assurance Project Plan (QAPP) for the above-referenced site. Enclosed please find one copy of each table incorporating the revisions. Please replace the tables in the QAPP submitted May 1986 with the enclosed tables.

If you have any questions regarding this matter, please contact us.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Frank D. Hale
Research Manager

DC:jd:17:37

cc: Mr. D.M. Crawford

O'Brien & Gere Engineers, Inc.
Executive Park, 1304 Buckley Road, Syracuse, NY 13221 (315) 451-4700

copy of final QAPP signature page

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN (QAPP)

GRANITE CITY SITE

GRANITE CITY, ILLINOIS

APPROVALS:

USEPA REGION V
REMEDIAL PROJECT MANAGER
Edward W Bradley
Date: 7/30/86

USEPA REGION V
QUALITY ASSURANCE OFFICER
James M. Adams Jr.
Date: 7/22/86

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL PROJECT MANAGER
Timothy M. Miller
Date: 7-14-86

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
QUALITY ASSURANCE OFFICER
Lina Shah Hecke
Date: 7.14.86

O'BRIEN & GERE ENGINEERS, INC.
PROJECT OFFICER
J B Humphrey Jr
Date: 6/26/86

OBG LABORATORIES, INC.
QUALITY ASSURANCE OFFICER
Daniel C. Pell
Date: 6/26/86

PREPARED BY:

O'BRIEN & GERE ENGINEERS, INC.
1304 BUCKLEY ROAD
SYRACUSE, NEW YORK 13221

O'BRIEN & GERE

May 8, 1986

CERTIFIED MAIL
Return Receipt Requested

Director, Waste Management Division
USEPA, Region V
Attn: Brad Bradley (5 HE-12)
230 South Dearborn Street
Chicago, Illinois 60604

Director
Illinois Environmental Protection Agency
Attn: Jim Frank/John G. Hooker
2200 Churchill Road
Springfield, Illinois 62706

Re: Agreement and Administrative Order by Consent - NL Granite City Site
RI/FS Work, Safety, Sampling, and Quality Assurance Project Plans

File: 2844.012

Gentlemen:

Enclosed for your review are the RI/FS Work Plan, Safety Plan, Sampling Plan, and Quality Assurance Project Plan for the above-referenced project. These submittals incorporate revisions based on our conference calls of April 8 and April 9, 1986.

If you have any questions regarding the enclosed project plans, please contact us at your convenience.

Very truly yours,

O'BRIEN & GERE ENGINEERS, INC.

Frank D. Hale
Research Manager

DMC:jld:D11:43

cc: Mr. Stephen W. Holt - NL Industries
Mr. Douglas M. Crawford

O'Brien & Gere Engineers, Inc.
Box 4873 / 1304 Buckley Road / Syracuse, NY 13221 / (315) 451-4700
Blue Bell, PA / Boston, MA / Landover, MD / New York, NY / St. Louis, MO / White Plains, NY

2844.012

WORK PLAN

NL INDUSTRIES, INC.
GRANITE CITY SITE
GRANITE CITY, ILLINOIS

O'BRIEN & GERE ENGINEERS, INC.
1304 BUCKLEY ROAD
SYRACUSE, NEW YORK 13221

TABLE OF CONTENTS

SECTION 1 - OVERVIEW

1.01 General

The secondary lead smelting facility and surrounding property in Granite City, Illinois was sold by NL Industries (NL) to Taracorp in 1979. Figure 1 presents a location map for the Granite City Site. During 1983, Taracorp filed for protection from creditors, and NL Industries has elected to take the lead in identifying appropriate remedial options. NL Industries is currently in the process of negotiating an agreement with the Illinois Environmental Protection Agency (IEPA) relative to the remediation of this site.

The agreement addresses the potential impacts of the site on human health and the environment by specifying a series of studies to identify existing conditions and an appropriate remedial approach. This agreement will require the preparation of detailed engineering reports in accordance with a schedule yet to be determined. Implementation of the appropriate remedial options will occur subsequent to the IEPA and USEPA approval of the approach.

1.02 Background

The Granite City Site has been used for secondary lead smelting since before 1905. At that time the facilities included a shot tower, machine shop, factory for the manufacturer of blackbird targets, sealing wax, manufacture of mixed metals, refining of drosses, and the rolling of sheet lead. Since that time, additional facilities have been added to provide secondary smelting capability. Figure 2 presents a Process Flow Diagram for the facilities existing prior to February 1983.

Since then the blast furnace and the rotary furnace have been shut down, limiting production to lead alloying and fabricating.

Historically, solid wastes generated during the manufacturing operations were stored on-site in a slag storage area as illustrated in Figure 3. Among the materials reportedly disposed of in this area are: slag, baghouse dust in 55 gallon drums, and battery cases. The nature of the disposal operations is such that the contents of the waste pile would not be expected to be homogeneous. Visual examination of the waste pile indicates that battery cases are confined to the upper areas; this supports NL Industries' understanding that battery recycling facilities were not installed until the middle 1950's.

There is some indication that shredded plastic and hard rubber from battery cases was collected by local contractors for use in driveway and alley paving.

Liquid wastes from the manufacturing operation are discharged via process sewers to the municipal sewer system. Granite City utilizes combined sewers running under the Granite City Site to transport wastewater to treatment facilities.

Previous studies which have assessed conditions at the Granite City Site include an April 1983 report published by Illinois Environmental Protection Agency. In addition, the site was reviewed as part of the State Implementation Plan for the State of Illinois, and published in September 1983.

1.03 Project Objectives

The project objectives are to identify existing site conditions and impacts, and identify which, if any, remedial technologies would be appropriate. Several Reports will be submitted to the IEPA for review and approval. The culmination of this study will be the preparation of a Final Report which will identify the most cost effective and environmentally sound remedial alternatives.

1.04 Scope of Work

NL Industries, in conjunction with the IEPA, has identified a Statement of Work addressing the Remedial Investigation/Feasibility Study. This document is presented as Appendix A. Based on the approach negotiated between the IEPA and NL, several tasks have been identified. These tasks are conveniently separated into two sequential studies: Remedial Investigation and Feasibility Study. The Remedial Investigation is to consist of the following tasks:

Task 1 -- Description of Current Situation
Task 2 -- Investigation Support
Task 3 -- Site Investigations
Task 4 -- Preliminary Remedial Technologies
Task 5 -- Site Investigations Analysis
Task 6 -- Remedial Investigation Report
Task 7 -- Community Relations
Task 8 -- Additional Requirements

The feasibility study will comprise the following tasks:

Task 9 -- Description of Proposed Response
Task 10 -- Development of Alternatives
Task 11 -- Initial Screening of Alternatives
Task 12 -- Laboratory Studies
Task 13 -- Evaluation of Alternatives
Task 14 -- Conceptual Design
Task 15 -- Final Report
Task 16 -- Additional Requirements

As requested by NL Industries, O'Brien & Gere's proposal addresses the entire Remedial Investigation/Feasibility Study. O'Brien & Gere's approach to the Statement of Work is presented in detail in Section 2.

SECTION 2 - PROJECT APPROACH

2.01 General

O'Brien & Gere has developed a project approach to meet the key objectives which we feel are important to its timely and successful completion. The key objectives of this project approach are to:

1. Determine contaminant concentrations in the study area.
2. Identify transport routes and rates for contaminants of concern.
3. Identify impacted populations, if any.
4. Identify the most economical, technically sound approach to providing an acceptable level of risk to human health and the environment.

Through the years, it has become apparent that efficient communication between the Engineer and the Client is an important ingredient in a successful project. Additionally, we have learned that input from the Client on all aspects of a project will usually result in the timely and efficient completion of that project. Inherent in the project approach presented in this section are continual communications with and input from NL Industries personnel.

O'Brien & Gere possesses a number of key attributes which we feel will allow us to meet the objectives of this project. These attributes include:

Complete Engineering Services. O'Brien & Gere is capable of providing a complete line of engineering services to achieve all the aspects of this project. O'Brien & Gere's standard engineering disciplines such as environmental, chemical, civil, electrical and mechanical capabilities are supplemented by our in-house research and analytical capabilities, computer services, and our contract administration capabilities. Additionally, OBG Technical Services, Inc., is available to implement any of the remediation portions of this project, if so desired by NL Industries.

Project Experience. O'Brien & Gere has been at the forefront of the hazardous waste field since the mid-1970's. We have successfully completed and currently have underway a number of projects which are similar in nature and in scheduling to the Remedial Investigation/Feasibility Study at the Granite City facility.

Project Team. The Project Team which O'Brien & Gere proposes to utilize to undertake this project has a proven track record in the successful and timely completion of projects similar to this project. The key members of the project team are outlined in detail in the Organization section of this proposal. The team is headed by

Cornelius B. Murphy, Jr., Ph.D., Senior Vice President responsible for all of O'Brien & Gere's hazardous waste and site remediation work. Day-to-day management of the program will be the responsibility of Frank D. Hale, Research Manager. Additional details on the Project Team and experience are contained in Section 3.

O'Brien & Gere has developed a project approach for the Remedial Investigation/Feasibility Study. The approach we propose to use in undertaking the work is outlined in the remainder of this section.

2.02 Remedial Investigation

The Remedial Investigation consists of eight tasks with a variety of subtasks as illustrated in Table 1. The proposed scope of work addresses all of the issues identified in the Statement of Work provided by NL Industries which is presented as Appendix A. A brief description of O'Brien & Gere's approach to each subtask is presented below. The purpose of this description is not to reproduce the Statement of Work but rather to clarify issues which might impact study costs. It is important to note that the projected level of effort for these tasks is based on perceived value in achieving the overall project objectives.

Task 1 - Description of Current Situation

The overall purpose of Task 1 is to determine what information is available for the Granite City Site. The site has been defined as the Taracorp property, identified off-site removal areas, and adjacent properties containing lead-contaminated piles.

Subtask 1a - Site Background

A 7.5-minute series topographic map will be prepared locating the Granite City Site and other industries of concern. An additional map will be prepared from tax maps of the Granite City area with a radius of two miles from the center of the Taracorp property. Finally, a drawing of the Taracorp property including adjacent properties will be prepared from existing drawings of the area.

A brief review of site history will be prepared based on information currently available in the State Implementation Plan (IEPA 1983), and in NL and Taracorp files. This will include a brief description of current manufacturing activities.

The objective of this exercise is to identify what materials of environmental significance may be found in the study area. This will help focus the analytical program and thus minimize analytical expenses.

Subtask 1b - Nature and Extent of Problem

The objectives of this task will be to collect, review and evaluate all existing information pertinent to the storage, disposal and movement of expected contaminants in the study area relative to

the extent that they affect exposed biological entities. The information will be used to identify the scope of the problem and provide direction to activities carried out in subsequent tasks.

Output from this task will take the form of a preliminary hazard assessment. The information will be reviewed to determine the extent and quality of data available on each of the following key factors:

- Receptors: Population of humans and other organisms that may have been or may be exposed to materials originating on-site will be identified.

- Site Characteristics and Pathways: The routes or media by which materials may be escaping from the site will be determined.

- Waste Characteristics: The hazardous properties of the waste including its quantity, chemical form, environmental chemistry and toxicity will be documented.

- Waste Management Practices: The current and past procedures for the storage and prevention of off-site movement of wastes will be reviewed to identify sources, locations and the volume of wastes existing at on and off-site locations.

This hazard assessment will provide information necessary for the preparation of the Work Plan required by the IEPA. The Work Plan will provide IEPA with details on sampling sites, frequencies and parameters to be analyzed. As the objective of the project is to remediate to the extent that acceptable risk is achieved this task is the foundation for the project.

Subtask 1c - History of Response Actions

This subtask will include the preparation of a document containing all relevant data available as well as a bibliography of identified sources. The prepared document will assist in the focusing of study efforts.

Subtask 1d - Remedial Investigation Work Plan

The Statement of Work specifies that a detailed work plan be submitted to the USEPA and IEPA for approval. The scope and presentation of the Remedial Investigation Work Plan will depend on the information identified in Subtasks 1a through 1c. The Remedial Investigation Work Plan will likely not differ significantly from the Statement of Work; however, additional details will be required prior to regulatory approval. It is anticipated that O'Brien & Gere will prepare a Remedial Investigation Work Plan using the Statement of Work as the basis. The Work Plan will require details on sampling locations and frequencies and will also include additional sections on safety protocols, sampling and analysis, and quality assurance/control.

Task 2 - Investigation Support

Prior to initiating any field investigations, certain activities need to be completed. These tasks are listed and briefly described below.

Subtask 2a - Subcontractor Procurement

Based on the projected scope of work and the range of technical disciplines available within O'Brien & Gere, we anticipate subcontracting the subsurface drilling and well installation. These activities will be conducted according to O'Brien & Gere's specifications and will be supervised by one of our geologists.

Subtask 2b - Site Visit

An initial site visit was conducted by Dean Palmer, Frank Hale and Michael Scarpa. Information obtained by these individuals during that trip will be used to develop a site safety protocol. Therefore, no additional effort is anticipated for this subtask.

Subtask 2c - Define Boundary Conditions

The information generated during Task 1 will be used to identify the study area boundaries. These boundaries have been provisionally identified by the IEPA in the Statement of Work, however, off-site removal areas are unidentified at this time. It is O'Brien & Gere's understanding that the IEPA will be responsible for identifying any off-site disposal areas to be evaluated.

Subtask 2d - Site Map

Subtask 2d requires the preparation of a map with a grid system addressing the area within a radius of 1 mile of the waste pile. A scale of 1" = 300' will provide the required detail. An expanded scale drawing of the NL Industries site will be used to coordinate on-site investigations and present the results of these investigations. This drawing will be of the general form of Figure 3 and will be a full size drawing at 1"=50' scale. This drawing will be derived from Taracorp Industries Drawing #1869.

Subtask 2e - Site Office

O'Brien & Gere's St. Louis Office will serve as the site office identified as Task 2e in the Statement of Work. This office located approximately 15 minutes from the Granite City Site will be the coordination point for all project-related activities. Field investigations will be conducted by O'Brien & Gere staff with vehicles equipped for that activity.

Task 3 - Site Investigation

The objective of this task is to provide additional detailed data on site conditions through sampling and analysis. This data will provide the technical justification, for the level of remediation selected. Consequently the program selected and its implementation is of utmost importance. The tasks presented below provide an estimated level of effort based on our knowledge of this site the secondary lead industry and typical regulatory requirements studies conducted within Task 1 will be used to modify the Site Investigation if necessary. Areas of emphasis associated with this task are described briefly below with Table 2 presenting estimated analytical requirements.

Subtask 3a - Waste Characterization

The Statement of Work describes a very general sampling and analysis program. Based on the site visit and conversations with Bill Weddendorf, Fred Baser and George Webb, the waste stored on-site is limited to the large slag pile on the site and the hard rubber product pile associated with the St. Louis Lead Recyclers (SLLR) operation.

The slag pile includes slag, some drummed materials, battery cases, and related materials. Samples of slag will be collected manually as will the upper strata due to the nature of the pile. It is anticipated that geologic tools will be adequate for slag samples. Shovels will be used at the top of the pile and along the vertical face to provide representative samples of the upper strata. Sampling of the slag pile will include portions of four samples of slag (one sample from each quadrant of the slag pile) for digestion and analysis.

The slag pile materials in the upper strata are a mixture of shredded battery cases, dust, and drummed materials. Ten samples of the upper strata will be collected with shovels and sieved in the field. Those particles which pass through a 9.5 mm (0.375 in.) standard sieve will be submitted to the laboratory for analysis as presented in Table 2. Particles of this size might be expected to be transported from the site via wind or rain. Two samples of the drummed materials will be collected and submitted to the laboratory for analysis as presented in Table 2.

Two samples from the SLLR pile will be collected, sieved, and analyzed for these same constituents as shown in Table 2.

Subtask 3b - Hydrogeologic Investigation

The Granite City Site has been the subject of a surface and subsurface investigation to determine the horizontal and vertical extent of groundwater contamination. The hydrogeologic portion of the previous investigations has included test borings, soil sampling

and analysis, installation of monitoring wells and groundwater quality sampling and analysis. Figure 4 presents the locations of existing monitoring wells. The available data from this investigatory work suggests that metals and sulfate are the principal constituents of concern and that limited groundwater contamination exists.

Approach: The principle hydrogeologic concern at the site is the potential for groundwater contamination and the off-site plume migration. The literature information on solubility of and adsorption potential of the metals of concern (lead, cadmium and chromium) suggest that they have limited mobility in natural groundwater systems. The existing site groundwater quality data is supportive of the theoretical low mobility. The site data also suggests that the constituents of concern are somewhat mobilized vertically, possibly by precipitation percolating through the soils at the site and recharging the groundwater. However, the groundwater data suggest that off-site contaminate migration, if it exists, is very limited.

The scope of the proposed work effort will be two-fold: (1) a limited field program to fill gaps in and extent in the existing data base; and (2) a comprehensive literature review and data evaluation to develop and document the theory of relevant metal mobility to support the site data and the proposed remediation.

Field Investigation:

Test Boring

If necessary, subsequent to a review of existing groundwater data, one deep test boring, estimated depth 50 to 60 ft, will be drilled using a hollow-stem auger. Soil samples will be collected at 5 foot intervals or change in lithology using a standard split-spoon sampling technique (ASTM Method D-1586). Soil samples will be preserved in a glass jar with a teflon cap. Selected samples will be analyzed for the constituents of concern. Split-spoon sampling equipment will be cleaned between each sample using a soap wash followed by a distilled water rinse.

Monitoring Well

If the test boring discussed above is installed, one deep monitoring well (estimated depth of 50 to 60 ft), will be installed in the test boring to provide a groundwater quality monitoring point at depths in the aquifer. The well will be constructed of 5 ft of 2-inch ID flush jointed threaded Schedule 40 PVC with #10 slot (.01 inch) screen and 2-inch ID flush joint threaded Schedule 40 PVC casing. A two-foot bentonite grout seal will be installed above the screen and a concrete with bentonite plug and protective steel casing will be installed at the ground surface. The well will be developed to the satisfaction of the supervising hydrogeologist using compressed air or a stainless steel bailer.

Borehole Geophysical Logging

Existing wells will be logged using natural gamma borehole geophysics if deemed necessary from a review of existing well logs. Each single well and each deep well of a well nest will be logged to enable detailed identification of subsurface lithology and correlation between wells.

In-Situ Permeability Tests

In-situ permeability tests will be conducted on four wells, two shallow and two deep, in order to determine the hydraulic conductivity of the aquifer materials if deemed necessary from existing information. The tests will be conducted by rapidly withdrawing water from the well and monitoring the water level recovery.

Groundwater Quality

Groundwater sampling on all wells will be conducted for two quarters and analysis for selected constituents of concern will be performed. Table 2 presents the analytical program. Prior to sampling, each well will be purged to remove a minimum of three to five well volumes or until dry, whichever comes first. Sampling will be conducted according to O'Brien & Gere's sampling protocol, which meets regulatory agency requirements.

Literature Review

A comprehensive literature review will be conducted to identify all available information on the site and regional hydrogeology, and to develop and document the theory regarding the solubility, adsorption and mobility of the constituents of concern. The materials to be evaluated will depend on the results of the chemical characterization results.

Subtask 3c - Soils and Sediments Investigation

The IEPA has conducted a considerable number of soil analyses as suggested by Figure 5. However, to ensure that remedial measures are consistent with actual conditions, additional analyses are included in the Statement of Work. As presented in the Statement of Work, 36 grid points will be sampled on a 1,000 foot grid around the plant site. The sampling grid and associated locations are presented in Figure D-2 of Appendix D. Each grid point sample will be composed of four discrete samples collected approximately 20 feet from the grid point and composited. A composite sample of the top three inches and a composite representing the strata 3 inches to 6 inches below grade will be collected for an analysis of the total lead content. In addition, the off-site soil sample having the highest total lead concentration above 1000 ppm will be subjected to the EP Toxicity procedure for the metals shown in Table 2. Should Task 1 identify other materials to be

analyzed this will be discussed at that time with NL Industries. For planning purposes, it is estimated that 40 samples will require the further chemical analyses presented in Table 2.

Several off-site areas have been identified as areas to which battery cases were reportedly taken. These removal areas include several alleys, a large lot on Terry Street, and a ravine between Terry Street and Watson Street. Figures D-5 and D-6 indicate the locations of these areas. One sample will be collected from each of the alleys and the large lot on Terry Street. A maximum of four samples will be obtained from the ravine between Terry Street and Watson Street. Where site conditions permit, the samples will be obtained using the composite soil sampling procedures presented in Appendix D. If site conditions prohibit the use of the composite soil sampling procedures, the samples will be obtained employing the procedures used in sampling the slag pile upper strata. These procedures are also described in Appendix D. The samples will be analyzed for total lead as shown in Table 2.

Based on the preliminary site inspection and a review of the available site information, geophysical methods do not appear to be necessary. There is no evidence of fill activities on the site other than in the area of the slag pile, and geophysical methods are unlikely to be very successful at identifying conditions within the slag pile.

Subtask 3d - Surface Water Investigation

The site inspection conducted on March 15 revealed no continuously flowing surface water. Therefore, no surface water sampling is anticipated. Surface runoff from the waste pile(s) will be determined by examining drainage patterns and collecting four sediment samples deposited near catch basin entrances to the combined sewer system. In addition, four runoff samples will be collected during one rainfall event. As shown in Table 2, these samples will be analyzed for total lead.

Subtask 3e - Air Investigation

The principal mode of lead transport from the site that has been identified to date has been through atmospheric releases. The IEPA has conducted extensive analyses of the air quality associated with the site and identified major sources. Four ambient air sampling stations are identified in the IEPA's studies and are illustrated in Figure 5. It should be noted that air quality in the area has been within National Ambient Air Quality Standards since the shutdown of the furnace operations in February 1983. It is anticipated that ambient air monitoring will be continued by the IEPA during the course of this study.

O'Brien & Gere's approach to this subtask is to utilize the existing data and the State Implementation Plan (SIP) to estimate atmospheric releases from the slag pile. From a cursory review of

the SIP, it would appear that the slag pile is not a significant source of atmospheric lead contamination. A thorough review of the SIP during Task 1 and preliminary remedial technologies identified may suggest further air quality analyses by NL, however this work is not anticipated at this time.

Task 4 - Preliminary Remedial Technologies

Subtask 4a Pre-Investigation Action

The focus of O'Brien & Gere's effort will be to identify what, if any, risks are associated with the no action alternative. Should the projected risk be such that some action is justified, then on-site actions will be evaluated. These on-site actions may include localized paving, encapsulation, and/or recovery.

For off-site areas where unacceptable risks are likely, appropriate technologies will be identified as presented in the Statement of Work.

Subtask 4b - Post-Investigation Evaluation

Individuals experienced in the technologies identified in Subtask 4a will utilize data generated during the site investigation to identify alternatives deemed technically viable and of reasonable cost. This subtask will serve to focus effort during the Feasibility Study and will be an input to Task 5b.

Task 5 - Site Investigation Analysis

Subtask 5a - Data Analysis

Output of Tasks 1 through 4 will be used to formulate an estimate of the level of human health and environmental risk in the study area as a result of the activities conducted on the waste site. The product of this task will be a risk assessment identifying any existing and future populations whose health may be impacted and the probability that such impacts will occur if the situation is allowed to continue without remediation. The sources and routes of exposure contributing to the risk will be identified and a level of reduction of exposure will be delineated which must be achieved in order to reduce the existing risk to an acceptable level. The risk assessment will be used as the basis for determining the course and extent of remediation to be implemented.

Subtask 5b - Application to Preliminary Technologies

This task will use the data generated from Task 4b to identify the more technically viable approaches which will be evaluated in more depth during the Feasibility Study.

Task 6 - Remedial Investigation Report

This task is clearly defined in the Statement of Work.

Task 7 - Community Relations Support

For budgetary purposes it is assumed that the Project Manager will be required to attend one public meeting during the Feasibility Study.

Task 8 - Additional Requirements

Subtask 8a - Reporting Requirement

It is anticipated that the project duration for Tasks 1-8 will be 9 months; consequently, it is estimated that the submittal of six progress reports will be required. We anticipate that five reports will be letter reports addressing those issues identified in the Statement of Work.

Subtask 8b - Chain of Custody

Procedures used by O'Brien & Gere at several other sites will be used to ensure the integrity of any samples collected. These procedures are consistent with IEPA and USEPA standards.

Subtask 8c - Safety Plan

A company safety plan addressing all of the issues identified in the Statement of Work is included as Appendix B.

Subtask 8d - Quality Assurance/Project Plan (QAPP)

A QAPP plan has been included as part of work plans for other sites and reviewed as part of laboratory certification by regulatory authorities. A project-specific QAPP plan is attached as Appendix C. Also attached as Appendix D is the sampling plan for the remedial investigation.

2.03 Feasibility Study

The feasibility study consists of eight tasks with a variety of subtasks as illustrated in Table 3. The proposed scope of work addresses all of the issues identified in the Statement of Work. O'Brien & Gere's approach to the individual subtasks is presented below.

Task 9 - Description of Proposed Response

This task involves the preparation of the work plan for the Feasibility Study. The technolgies selected for review will be based on the results of the Remedial Investigations.

Task 10 - Development of Alternatives

Subtask 10a - Establishment of Remedial Response Objectives

This subtask identifies the site specific objectives for the response activities. These objectives are based on the public health and environmental concerns and must be agreed upon by the IEPA and USEPA.

Subtask 10b - Identification of Remedial Alternatives

The Statement of Work identified several remedial options to be considered. The summary list of alternatives to be screened will be submitted to the IEPA and USEPA.

Task 11 - Initial Screening of Alternatives

The Statement of Work clearly identifies the issues to be considered in the initial screening of alternatives. Fundamental to this screening is the net risk reduction achieved through each of the remediation alternatives being considered. The risk reduction will be coupled with cost to identify approaches likely to satisfy the project objectives. The results of the screening will be presented to IEPA and USEPA personnel at a meeting in Chicago. Results of that meeting will be documented in a letter report.

Task 12 - Laboratory Studies

Should Task 11 identify a remedial approach which is likely to require testing before regulatory approval, then this task would be required. The remedial alternatives to be evaluated have not been identified. Consequently, for the purposes of this scope of services no laboratory testing is assumed.

Task 13 - Evaluation of the Alternatives

Subtask 13a - Detailed Development of Remaining Alternatives

The Statement of Work is clear on the requirements for this subtask.

Subtask 13b - Environmental Assessment

This subtask requires a more detailed investigation of two to four alternatives identified from the initial screening activities in Task 11. This subtask not only reviews risks associated with various remedial approaches, but also considers compliance with regulatory requirements.

The product of this subtask will be an Environmental Information Document which will be submitted to the IEPA and USEPA.

Subtask 13c - Cost Analysis

A detailed cost estimate will be prepared for each alternative. The cost estimate will include the construction cost and annual operating and maintenance cost. A cash flow diagram will be prepared with a present worth calculated at an interest rate provided by NL Industries.

Subtask 13d - Evaluation and Recommendation of Cost-Effective Alternative

The information developed in the previous tasks will be used to identify the most cost effective remediation alternative.

Subtask 13e - Report

A Report will be prepared presenting the results of Tasks 9 through 13 and the recommended remedial alternative. The objective of this Report is to provide the IEPA and USEPA with enough information to approve the recommended approach. This Report will be examined in detail during public hearings; consequently it must be comprehensive and very carefully written. Following IEPA and USEPA review, a Preliminary FS Report will be submitted for public comment.

Task 14 - Conceptual Design

For the purposes of this scope of services, it is assumed that the remedial alternative selected is the same as that recommended in the Subtask 13e Report. The results of this activity will be included in the Report discussed as part of Task 15.

Task 15 - Final Report

The Feasibility Study Report will include the results of the studies conducted in response to Tasks 9 and 14. The Final Report will be submitted to the IEPA and USEPA.

Task 16 - Additional Requirements

The additional requirements identified in Task 8 which are relevant to Task 16 are limited to the Reporting Requirements. These progress Reports will be due every two months during the Feasibility Study duration.

SECTION 3 - ORGANIZATION

3.01 General

O'Brien & Gere utilizes a project organization to provide the management, technical expertise, and experience to effectively implement the project approach described in Section 2. The organization of the management team and the responsibilities of each member are discussed in Section 3.02. Section 3.03 presents the expertise of the key members of the project team and their role in implementing this project.

3.02 Management Team

The management team established for this project is headed by the Project Director, Dr. C.B. Murphy, Jr., Senior Vice President. Specific management responsibilities of the Project Director include: project performance evaluation, project quality, project schedule, project cost, personnel allocations and continuous monitoring and control of all program tasks.

F.D. Hale will serve as the Project Manager reporting directly to Dr. Murphy. The Project Manager is responsible for overseeing all facets of the project on a day-to-day basis, specifically the project schedule, cost, and quality of each task. Mr. Hale will also be responsible for all communication and coordination between O'Brien & Gere and NL Industries.

A Technical Advisory Committee (TAC) will be comprised of three of the most experienced staff of O'Brien & Gere in site investigation and remediation, D. L. Palmer, Managing Engineer, Dr. E.C. Tifft, Managing Engineer and R.D. Jones, Managing Engineer. The TAC monitors the progress and the quality of the various phases of the project through members of their respective staff working directly on the project. Their project involvement will be supplemented by having periodic reviews to gain full advantage of their knowledge and management skills throughout the duration of the project.

3.03 Project Team

The management team for this project will draw upon the technical expertise and experience of a number of different individuals. The team assembled for the Site Assessment portion of the Remedial Investigation is comprised of personnel with expertise in hydrogeology, water chemistry, and soil science. The Risk Assessment staff will be headed by Dr. S.W. Kaczmar, an Environmental Toxicologist who has conducted risk assessments for a number of O'Brien & Gere projects. The Remedial Technologies evaluation will be staffed by civil engineering personnel with experience in this type of technology assessment.

The personnel that would be involved with assessing each remedial approach were selected on the basis of their experience appropriate to that specific method. Dr. Kaczmar and his risk assessment team will provide the environmental assessment support for the remedial approaches identified.

3.04 Project Schedule

The required schedule for implementing the work detailed in Section 2 is noted in Section F of the Agreement and Administrative Order by Consent which became effective on May 14, 1985.

Tables

O'BRIEN & GERE

TABLE 2

REMEDIAL INVESTIGATION

ANALYTICAL PROGRAM

JUNE 1986 REVISION

	Sample Site	#	Field Sieve[1]	Lab Sieve[2]	Digest	Ext.	Filt.	pH	Cond.	Pb	Cd	Cr	Ba	As	Hg	Se	Ag	Sb	Cu	Fe	Mn	Ni	Zn	SO_4	TDS
3a																									
	Slag	4	--	4	4	2	--	--	--	4	4	4	4	4	4	4	4	4	4	4	4	4	4	--	--
	Upper Strata	10	10	--	10	5	--	--	--	10	10	10	10	10	10	10	10	10	10	10	10	10	10	--	--
	SLLR Pile	2	2	--	2	1	--	--	--	2	2	2	2	2	2	2	2	2	2	2	2	2	2	--	--
	Drummed Material	?	--	--	*	1	--	*	*	?	?	?	?	?	?	?	?	?	?	?	?	?	?	--	--
3b																									
	Wells Quarter - 1	15	--	--	3	--	12	15	15	15	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Wells Quarter - 2	15	--	--	3	--	12	15	15	15	12	12	12	12	12	12	12	**	**	**	**	**	**	**	**
3c																									
	Soils Grid	72	--	72	72	--	--	--	--	72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Off-Site Removal Areas	11	--	11	11	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3d																									
	Deposition	4	--	--	4	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Runoff	4	--	--	4	--	--	4	4	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

1 Field sieving indicates that samples will be sieved in the field through a 9.5 mm standard sieve. That portion passing through the sieve will be collected and submitted for analysis.

2 Lab sieving indicates that soil samples will be sieved through a 16 mesh stainless steel sieve after drying (8 hours at 100°C, or until dry), prior to analysis. Slag samples will be crushed and sieved through a 9.5 mm standard sieve in the laboratory prior to analysis.

* If the drummed materials are solid wastes, they will undergo digestion. If they are liquid wastes, they will be tested for pH and conductivity in the field.

** Second quarter groundwater samples will be analyzed for those parameters observed in significant concentrations in the first quarter groundwater analysis, as jointly agreed upon by USEPA, IEPA, and NL Industries.

The analytical program is to include one EPA Toxicity (Metals only) for Off-Site soils with highest Pb if over 1000 ppm.

In the event that activities in Task 1 determine that environmentally significant parameters are present, these parameters will be included in 3a and/or 3b1 above, for utilization where parameter involvement is suspected.

The preceding narrative is modified by reference to be consistent with this table. In the event of a discrepancy between this table and the RIWP, this table will be governing.

TABLE 1
REMEDIAL INVESTIGATION
WORK PLAN OUTLINE

TASK 1 Description of Current Situation

- 1a Site Background
- 1b Nature and Extent of Problem
- 1c History of Response Actions

TASK 2 Investigation Support

- 2a Subcontractor Procurement
- 2b Site Visit
- 2c Define Boundary Conditions
- 2d Site Map
- 2e Site Office

TASK 3 Site Investigations

- 3a Waste Characterization
- 3b Hydrogeologic Investigation
- 3c Soils and Sediments Investigation
- 3d Surface Water Investigation
- 3e Air Investigation

TASK 4 Preliminary Remedial Technologies

- 4a Pre-Investigation Evaluation
- 4b Post-Investigation Evaluation

TASK 5 Site Investigation Analysis

- 5a Data Analysis
- 5b Application to Preliminary Technologies

TASK 6 Remedial Investigation Report

TASK 7 Community Relations

TASK 8 Additional Requirements

- 8a Progress Reports
- 8b Chain of Custody
- 8c Safety Plan
- 8d Quality Assurance/Quality Control/Sampling Plan

TABLE 3
FEASIBILITY STUDY
WORK PLAN OUTLINE

TASK 9 Description of Proposed Response

TASK 10 Development of Alternatives

- 10a Response Objectives
- 10b Identification of Remedial Alternatives

TASK 11 Initial Screening of Alternatives

TASK 12 Laboratory Studies (Optional)

TASK 13 Evaluation of Alternatives

- 13a Detailed Development of Remaining Alternatives
- 13b Environmental Assessment
- 13c Cost Analysis
- 13d Evaluation and Recommendation of Cost-Effective Alternative
- 13e Report

TASK 14 Conceptual Design

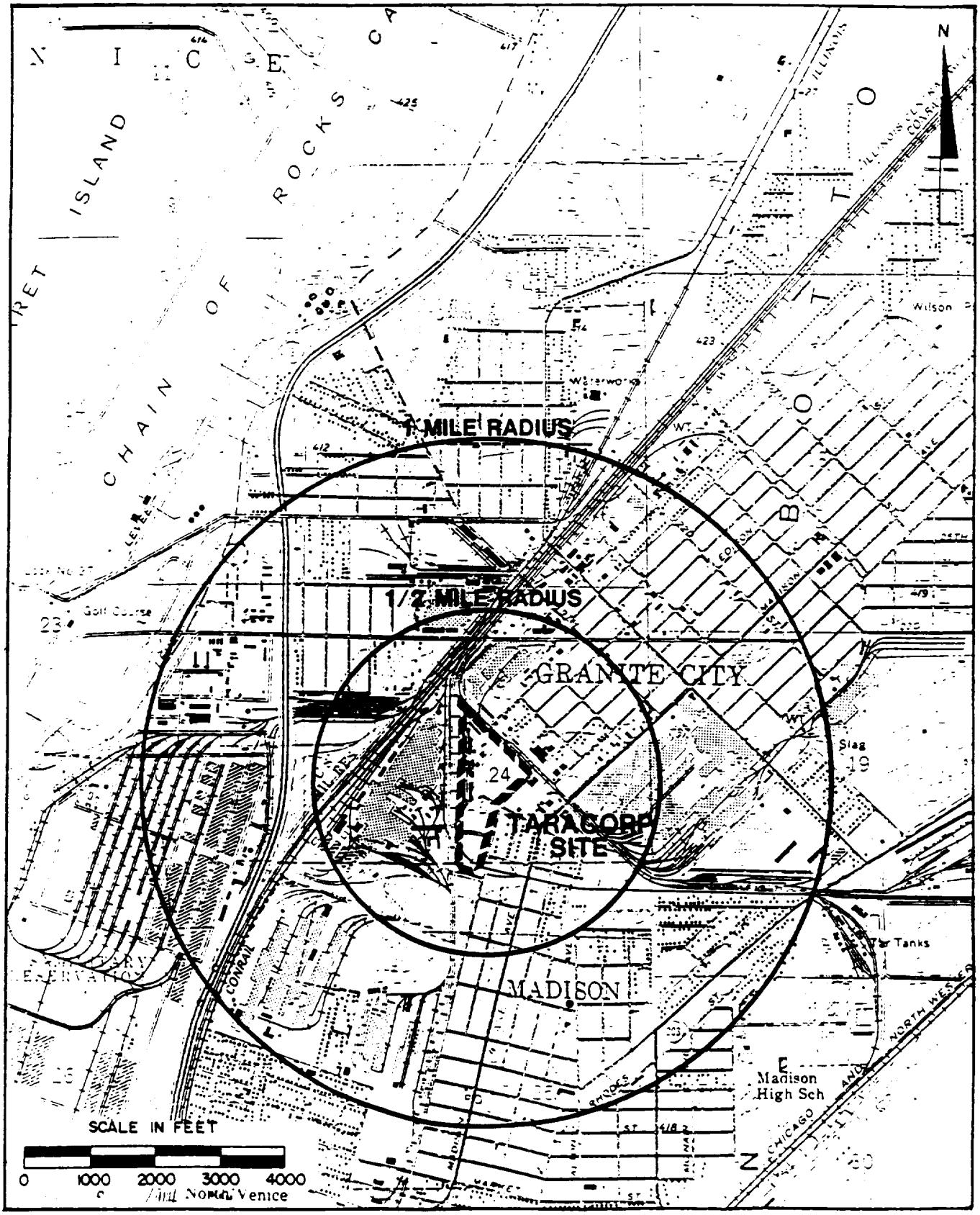
TASK 15 Final Report

TASK 16 Additional Requirements

Figures

FIGURE 1

LOCATION MAP



PROCESS FLOW DIAGRAM FOR TARACORP SECONDARY LEAD SMELTER

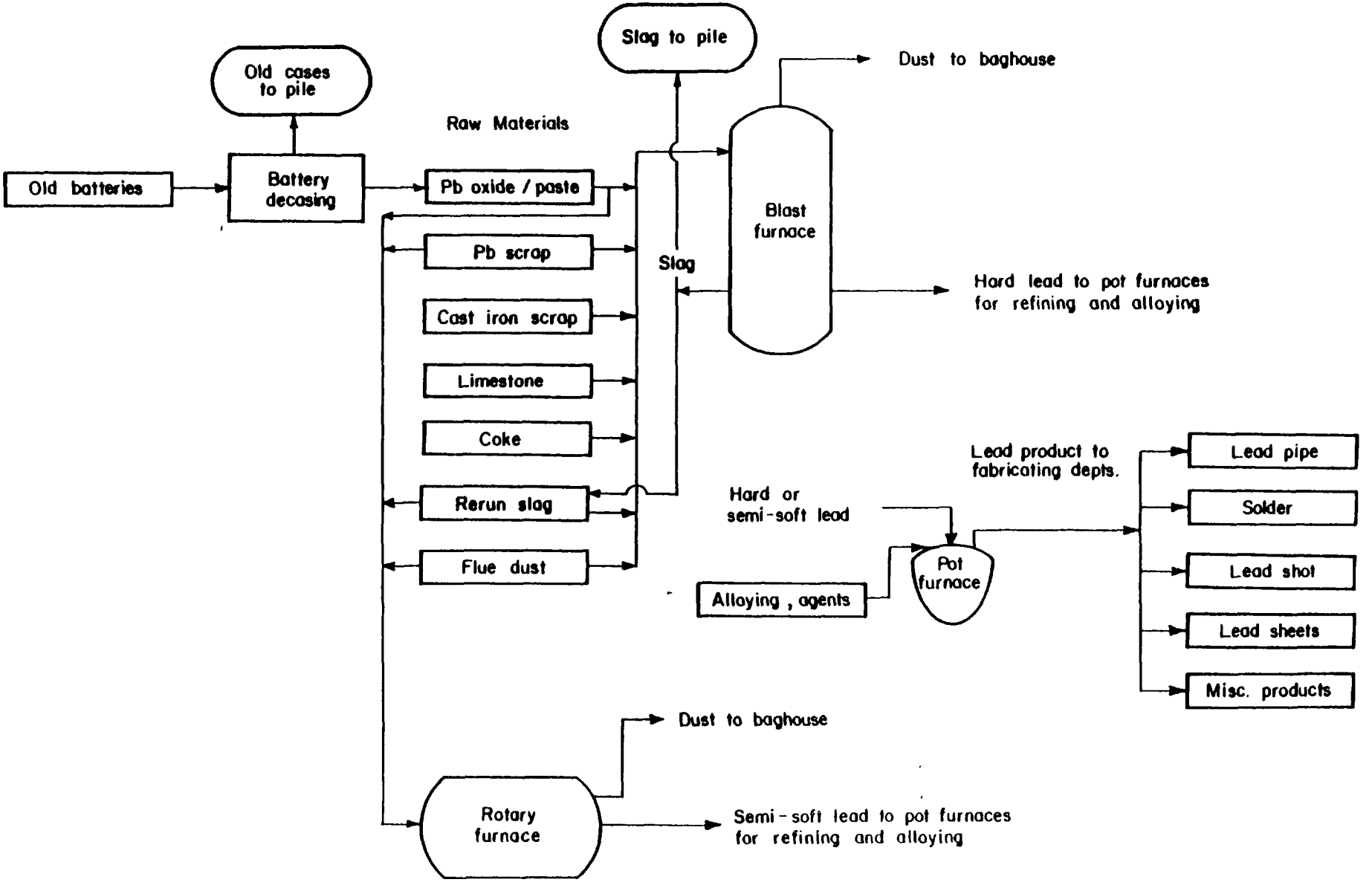
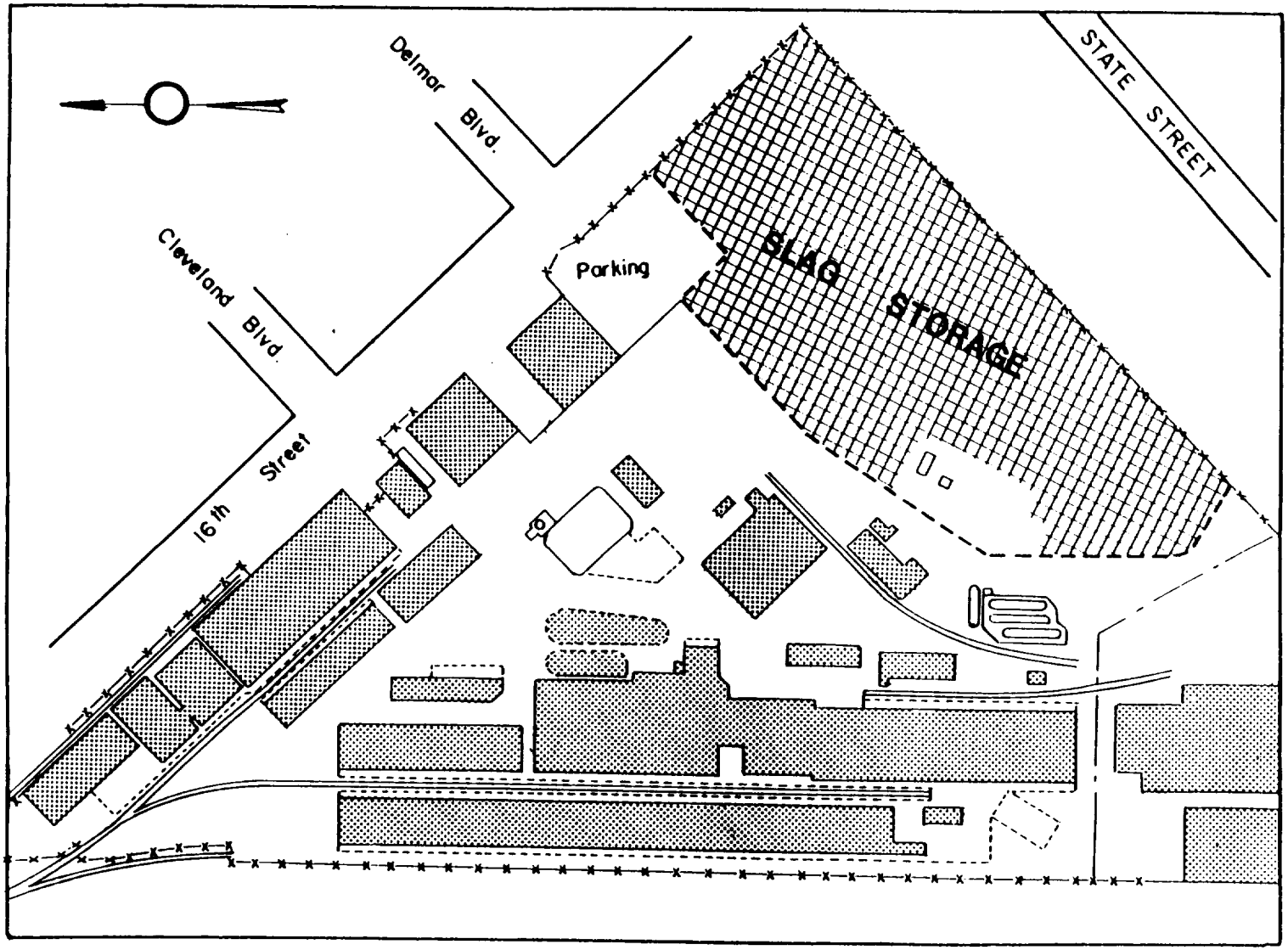


FIGURE 2



TARACORP SITE PLAN

Scale

1" = 160'

160 80 0 80 160

FEET

FIGURE 3

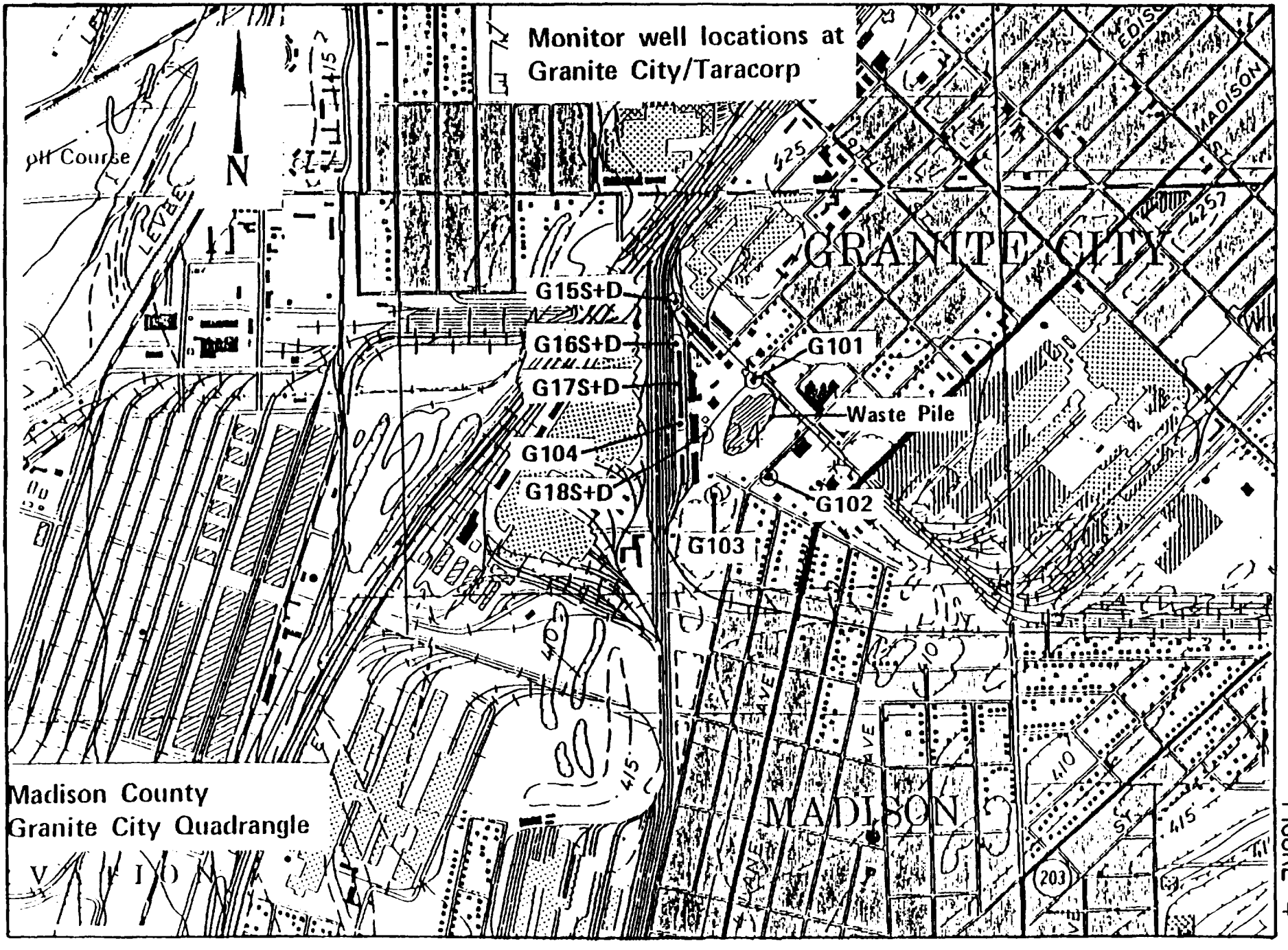
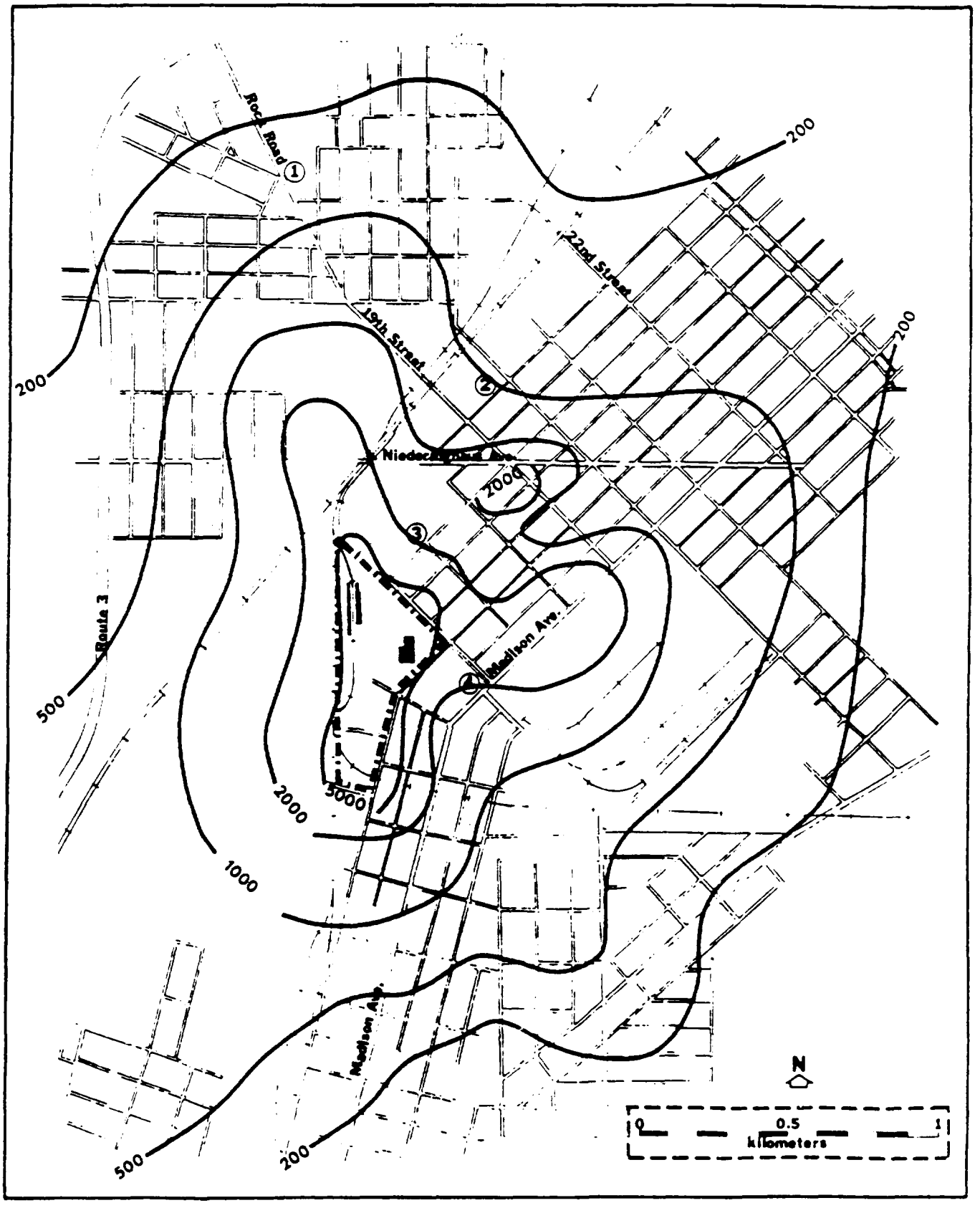

Monitor well locations at
Granite City/Taracorp
G15S+D
G16S+D
G17S+D
G104
G18S+D
G103
G101
Waste Pile
G102
GRANITE CITY
MADISON
pH Course
LEVEE
Madison County
Granite City Quadrangle
N
425
415
410
203

FIGURE 4

FIGURE 5

LEAD CONCENTRATION IN SURFACE SOIL (ppm)



Appendix A

APPENDIX A

REMEDIAL INVESTIGATION
STATEMENT OF WORK

PURPOSE:

The purpose of this remedial investigation is to determine the nature and extent of the problem at the site and gather all necessary data to support the feasibility study. NL Industries, either alone or as a representative of resonsible parties, or an Engineer retained by them shall furnish all personnel, materials, and services necessary for or incidental to performing the remedial investigation of conditions resulting from lead smelting and related activities in the Granite City, Illinois area.

SCOPE:

The remedial investigation consists of eight tasks:

Task 1 -- Description of Current Situation

Task 2 -- Investigation Support

Task 3 -- Site Investigations

Task 4 -- Preliminary Remedial Technologies

Task 5 -- Site Investigations Analysis

Task 6 -- Remedial Investigation Report

Task 7 -- Community Relations

Task 8 -- Additional Requirements

A detailed work plan shall be submitted to USEPA and IEPA for approval. The plan shall also include technical approach, personnel qualifications, and a schedule for completing the proposed remedial investigation.

REMEDIAL INVESTIGATION
WORK PLAN SCHEDULE

	TASK	Product	Target Completion Week for Tasks (*) and Products (**)	Personnel Work Hours
1.	Description of Current Situation		*	
1a.	Site Background			
1b.	Nature and Extent of Problem			
1c.	History of Response Actions			
2.	Investigation Support		*	
2a.	Sub-Contractor Procurement	RFP (or IFB)	**	
2b.	Site Visit			
2c.	Define Boundary Conditions			
2d.	Site Map	Map	**	
2e.	Site Office			
3.	Site Investigations	Investigations	*, **	
3a.	Waste Characterization			
3b.	Hydrogeologic Investigation			
3c.	Soils and Sediments Investigation			
3d.	Surface Water Investigation			
3e.	Air Investigation			
4.	Preliminary Remedial Technologies		*	
4a.	Pre-Investigation Evaluation			
4b.	Post-Investigation Evaluation			

REMEDIAL INVESTIGATION
WORK PLAN SCHEDULE (Cont)

	TASK	Product	Target Completion Week for Tasks (*) and Products (**)	Personnel Work Hours
5.	Site Investigations Analysis		*	
5a.	Data Analysis			
5b.	Application to Preliminary Technologies			
6.	Remedial Investigation Report	Remedial Investigation Report	*, **	
7.	Community Relations		*	
8.	Additional Requirements	Safety Plan QA/QC Plan	*, **	

TASK 1 -- DESCRIPTION OF CURRENT SITUATION

The Engineer shall describe the background information pertinent to the site and its problems and outline the purpose and need for remedial investigation at the site. The data gathered during any previous investigations or inspections and other relevant data should be used. The site investigated shall include the Taracorp property, identified off-site removal sites, including alleys, parking lots and landfills and adjacent properties containing lead-contaminated piles.

a. Site Background. Prepare a summary of the regional location, pertinent area boundary features, and general site physiography, hydrology, and geology. The total area of the site and the general nature of the conditions, including pertinent history relative to the use of site for hazardous waste disposal, should be defined. The site investigated shall include the Taracorp property, identified off-site removal sites, including alleys and parking lots that are not impermeably paved, and landfills and adjacent properties containing lead-contaminated piles.

   As a minimum, site background shall include the following for the plant site and affected areas:

   1. Maps showing the following information with descriptions as necessary;
      a) The general geographical location;
      b) Taracorp plant property and property lines, waste and waste piles, raw material, and finished product storage areas;
      c) Industrial, commercial properties immediately adjacent to Taracorp property, including property lines of each property;
   2. A reasonable history of all lead smelting and other processes at this plant site and at associated industries in the immediate plant area.
   3. A general description of the current operations and associated lead processing industries at Taracorp and in the immediate area.

b. Nature and Extent of Problem. Prepare a summary of the information available on actual and potential on-site and off-site health and environmental effects. This may include, but is not limited to, identifying, and evaluating sources of lead emissions, discharges and contamination in the area, the type, physical states, and estimated amounts and locations of the hazardous substances, the existence and conditions of waste piles, storage areas, process and control equipment, drums, landfills, and lagoons affected media and pathways of exposure, contaminated releases such

as emissions and leachate or runoffs, and any human exposure. Emphasis should be placed on describing the threat or potential threat to public health, including threats to the public from inhalation of airborne particulates from the entire plant site and the waste storage piles and other open areas. Available previous sampling, blood testing and health studies should be used in this evaluation.

c. History of Response Actions. Prepare a summary of all previous response actions conducted by local, State, Federal or private parties, including site inspection, other technical reports, and their results. A list of reference documents and their location shall be included. The scope of the RI/FS should be developed to address the problems and questions that have resulted from the previous work at the site.

TASK 2 -- INVESTIGATION SUPPORT

The Engineer shall conduct preliminary work necessary to conduct the site investigations and feasibility study.

a. Subcontractor Procurement. Prepare subcontractor procurement documents and award sub-agreement to secure the services necessary to conduct the remedial investigation and feasibility study.

b. Site Visit. Conduct initial site visits required to become familiar with site topography, access routes, and proximity of receptors to possible contamination, and collect data for preparation of the site safety plan. The visit should be used to verify the site information developed in Task 1.

c. Define Boundary Conditions. Establish site boundary conditions to limit the area of site investigations. The boundary conditions should be set so that subsequent investigations will cover the contaminated media in sufficient detail to support following activities (e.g., the feasibility study). The boundary conditions should also be used to identify boundaries for site access control and site security.

d. Site Map. Initial map(s) and a grid system of the area within 1.0 mile of the waste pile will be developed. All wetlands, water features, drainage patterns, landfills, tanks, streets, commercial, industrial, residential and public property and other features will be depicted. The site map(s) and any topographic surveys will be of

sufficent detail and accuracy to locate and report all existing and future work performed at the area. [Permanent baseline monuments, bench marks and reference grids shall be tied into either USGS or State reference systems.] If remedial action is appropriate, the map(s) will be revised as necessary to include utilities, paved areas, easements and rights-of-way.

e. Site Office. An office will be identified to be used by the Engineer in support of site work.

TASK 3 -- SITE INVESTIGATIONS

The Engineer shall conduct only those site remedial investigations necessary to characterize the site and its actual or potential hazard to public health and the environment. The site investigations should also result in data of adequate technical content to assess preliminary remedial alternatives developed in Task 4 and support the detailed evaluation of alternatives during the feasibility study.

All sample analyses will be conducted at laboratories following EPA protocols, or equivalents. Strict chain-of-custody procedures will be followed and all samples will be located on the site map [and grid system] established under Task 2.

a. Waste Characterization. Develop and conduct a complete sampling and analysis program to characterize all materials of interest at the site. These materials could include wastes stored above or below ground in tanks, drums, lagoons, piles or other methods of storage. This must include a description of the methodology chosen for estimating the characteristics of the waste piles, including quantitites of lead and other hazardous materials, for each waste storage pile on the Taracorp property, on commercial and industrial properties adjacent to the Taracorp property and on other areas including roadways, open areas, and materials handling areas on both the Taracorp property and adjacent commercial and industrial areas. A sampling plan will be developed showing the locations, quantity, frequency, numbering, and constituents for analysis for each sample.

The sampling plan shall describe the sampling and analysis techniques appropriate to the site conditions. These techniques may include tank and drum opening, sample packing and shipping, and sample preservation. The number or frequency of sampling to obtain representative data should also be discussed. Elements of the safety plan and the QA/QC plan described in the "Additional Requirements" section will also apply to sampling.

The sampling plan should discuss potential incompatability of wastes. Wastes should be analyzed and grouped in compatability classes. This analysis should support any subsequent conclusions about segregating wastes on-site and developing preliminary remedial alternatives.

b. Hydrogeologic Investigation. Develop and conduct a program to determine the present and potential extent of ground water contamination and to evaluate the suitability of the site for on-site waste containment. Identify specific aquifer to be studied. Efforts should begin with a survey of previous hydrogeologic studies and other existing data. The survey should address the degree of hazard, the mobility of pollutants considered from Waste Characterization, the soils attenuation capacity and mechanisms, discharge/recharge areas, regional flow direction and quality, and effects of any pumping alternatives described in Task 4. It must also include analysis of the existing or potential contamination of groundwater from all sources of lead on the site, particularly the waste storage piles and all underground storage tanks. The present and future potential uses of the local groundwater resources must be investigated. Such information may be available from the USGS, the Soil Conservation Service, and local well drillers. Subsequent to the survey of existing data, a sampling program should be developed to determine the horizontal and vertical distribution of contaminants and predict the long-term disposition of contaminants. The sampling program should, at a minimum, evaluate factors affecting ground water quality, background levels of contamination, the type of well construction utilized (must be compatible with type of measurement taken), the number and location of wells, chain of custody and record of samples, and the ground water sampling method. Geophysical techniques should be considered for use in defining subsurface conditions and design of the sampling program.

c. Soils and Sediments Investigation. Develop and conduct a program to determine the location and extent of contamination of surface and subsurface soils and sediments. Specific areas to be studied will be identified. Threats to the public from ingestion of contaminated soils both on the plant site and in areas within one-half mile of the plant, and in all known off-site removal areas shall be evaluated. This initial survey will consist of samples taken on a 1000 foot grid interval. Parameters for additional sampling, within and without this one-half mile radius, will be developed.

Particular attention shall be given to schools, parks, alleys and residential areas where children may play and inadvertently ingest quantities of contaminated soil. This process may overlap with certain aspects of the hydrogeologic study (e.g., characteristics of soil strata are relevant to both the transport of contaminants by ground water and to the location of contaminants in the soil; cores from ground water-monitoring wells may serve as soil samples). A survey of existing data on soils and sediments may be useful. A sampling program should be developed and conducted to determine the horizontal and vertical extent of contaminated soils and sediments. Levels of soil contamination must be shown on appropriate maps. Information regarding local background levels, degree of hazard, location of samples, techniques utilized, and methods of analysis should be included. The investigation should identify the locations and probable quantities of subsurface wastes, such as buried drums, through the use of appropriate geophysical methods.

d. Surface Water Investigation. Develop and conduct a program to determine the extent of contamination of continuously flowing surface water within the study area. This process may overlap with the soils and sediments investigation; data from stream or lake sediments sampled may be relevant to surface water quality. A survey of existing data on surface water flow quantity and quality must be included. A sampling program must be developed and conducted, discussing the degree of hazard, including information on local background levels, location and frequency of samples, sampling techniques, and method of analysis. The amounts of lead which are deposited on streets and other areas (especially public areas) as the result of surface run-off from the waste pile shall be evaluated and determined. The potential reentrainment of this contamination into adjoining areas shall be determined.

e. Air Investigation. Develop and conduct a program to determine the extent of atmospheric lead contamination. Where appropriate, this must include a determination of the emissions rates of lead from each process source (for maximum allowed operating conditions) and from each fugitive source in the plant and in the area significantly impacted by the plant. The area significantly impacted by the plant will be specified by the IEPA, and will generally extend no more than two miles beyond the plant boundary. Determination of the geographical locations and stack parameters (i.e., stack heights, exit gas velocity, exit

gas temperature, and stack diameter) must be made for each process lead source within the significant impact area. For each fugitive source, geographical location as well as horizontal and vertical extent must be identified. The amount of lead which is deposited by process and other activities on streets and other areas accessible to the public must be determined.

Air quality analyses, including detailed dispersion modeling techniques must be conducted or, where available, analyzed using the source data collected above. The potential for buildings affecting the flow of the airborne lead emissions must be investigated. The ground level lead air concentration values must be projected in the vicinity of the lead sources using meteorological conditions and receptor locations as specified in applicable USEPA guideline documents. Current and historical air monitoring data in the area must be reviewed and evaluated to determine whether additional air monitoring sites are necessary. Based on all of the air quality analyses, the primary sources of lead must be identified and control techniques defined which will assure that future air quality levels are within acceptable limits (i.e., the National Ambient Air Quality Standards).

Where appropriate, the extensive analysis done by IEPA in support of the proposed State Implementation Plan (SIP) for lead may be used.

TASK 4 -- PRELIMINARY REMEDIAL TECHNOLOGIES

The Engineer will identify preliminary remedial technologies, providing detail sufficient to ensure that site investigations will develop a data base adequate for the evaluation of alternatives during the feasibility study.

a. Pre-Investigation Action. Prior to starting any site investigations, the Engineer will assess the anticipated site conditions to determine potential categories of source control and off-site remedial actions. This must include, as a minimum, analyses of the following:

1. Source Control Action

i. What containment techniques appear feasible to prevent contamination of ground water?

ii. Does incineration or reclamation appear to be a viable option?

iii. Does on-site treatment appear to be a viable option, and if so, what category of treatment should be investigated (e.g., biological, physical, chemical, thermal)? This must include an evaluation of washing technologies and techniques.

iv. Will substances migrate or continue to migrate off-site if no action is taken? If only source control measures are taken?

2. Off-Site Actions

i. Does the apparent volume of contaminated ground water, if any, make investigation or treatment impracticable?

ii. What technologies are available to treat the identified contaminants at the site?

iii. What technologies exist to effectively remove off-site contaminated materials?

iv. What technologies are available to control or contain the identified contaminants at the site?

v. Will the off-site contamination continue to pose a threat if no action is taken?

The IEPA will review and screen the preliminary technologies so that the site investigations can be designed to answer these types of questions and support the feasibility study.

b. Post-Investigation Evaluation. Either during or following the site investigations, the Engineer will assess the investigation results and recommend preliminary remedial technologies likely to apply to the site problem. These technologies should be a refinement of the options considered in Task 4a. They will provide the basis for developing detailed alternatives and the cost-effectiveness analysis during the feasibility study. The work during the remedial investigation will generally be limited to the following:

1. Recommending types of remedial technologies appropriate to the site conditions.

2. Recommending whether or not to remove some or all of the waste for treatment, storage, or disposal.

3. Determining the compatability of groups of wastes with other wastes and with materials considered as part of potential remedial action (e.g., slurry walls, lagoon liners). Recommending alternatives for treatment, storage, or disposal for each category of compatible waste.

TASK 5 -- SITE INVESTIGATIONS ANALYSIS

The Engineer shall prepare a thorough analysis and summary of all site investigations and their results. The objective of this task will be to ensure that the investigation data are sufficient in quality and quantity to support the feasibility study.

The results and data from all site investigations must be organized and presented logically so that the relationships between site investigations for each medium are apparent.

a. Data Analysis. Analyze all site investigations and develop a summary of the type and extent of contamination at the site. This analysis must include all significant pathways of contamination and an exposure assessment. Where practicable, the exposure assessment shall analyze the contribution of discrete sources of exposure to the overall assessment so as to provide an accountability analysis of the different sources. The exposure assessment should describe any threats to public health, welfare, or the environment. The analysis should discuss the degree to which either source control or off-site actions or combinations thereof, are required to significantly mitigate the threat to public health, welfare, or the environment. If the results of the investigation indicate that no threat or potential threat exists, a recommendation to stop the remedial response should be made.

b. Application to Preliminary Technologies. Analyze the results of the site investigations in relation to the preliminary remedial technologies developed in Task 4. Data supporting, or rejecting, types of remedial technologies, compatability of wastes and construction materials, and other conclusions should be presented.

TASK 6 -- REMEDIAL INVESTIGATION REPORT

The Engineer shall prepare a draft report covering the remedial investigation phase and submit 5 copies each to USEPA and IEPA. The report shall include the results of Task 1 through 5, and should include additional information in an appendix. The report shall be structured to enable the reader to cross-reference with ease. Comment from USEPA and IEPA shall be incorporated into the final report of which 5 copies each shall be submitted to USEPA and IEPA.

TASK 7 -- COMMUNITY RELATIONS SUPPORT

The Engineer may be required to furnish the personnel, services, materials and equipment required to assist in USEPA's or IEPA's community relations program. Although this may be a limited program, community relations must be integrated closely with all remedial response activities. The objectives of this effort are to achieve community understanding of the actions taken and to obtain community input and support prior to selection of the remedial alternative(s).

Community relations support shall consist of the following:

- Provide information for news releases, fact sheets and other materials prepared by USEPA or IEPA to apprise the community of current or proposed actions.

- Participation in public meetings, project review meetings, and other meetings as necessary to the normal progress of the work.

TASK 8 -- ADDITIONAL REQUIREMENTS

a. Reporting Requirements

Reports shall be prepared every other month by the Engineer and submitted to IEPA and USEPA that describe the technical progress of the project. These reports should discuss the following items:

1. Identification of site and activity.
2. Status of work at the site and progress to date.
3. Percentage of completion.
4. Difficulties encountered during the reporting period.
5. Actions being taken to rectify problems.
6. Activities planned for the next month.
7. Changes in key personnel.

The progress report will list target and actual completion dates for each element of activity including project completion and provide an explanation of any deviation from the milestones in the work plan schedule. Significant developments shall be reported as soon as practicable. All inquiries shall be directed through NL's designated project manager and shall be responded to.

b. Chain-of-Custody. Any field sampling collection and analyses conducted shall be documented in accordance with chain-of-custody procedures as provided by IEPA and USEPA.

c. Safety Plan. A safety plan will be developed to protect the health and safety of personnel involved in the remedial investigation. The plan will be consistent with:

- Section 111(c)(6) of CERCLA
- USEPA Order 1440.1 -- Respiratory Protection
- USEPA Order 1440.3 -- Health and Safety Requirements for Employees Engaged in Field Activities
- USEPA Occupational Health and Safety Manual
- Other USEPA guidance as provided
- State safety and health statutes
- Site conditions
- USEPA Interim Standard Operating Safety Guide

This safety plan shall be submitted to USEPA and IEPA.

d. Quality Assurance/Quality Control (QA/QC). The Engineer shall prepare and submit as part of the work plan a Quality Assurance Project Plan for the sampling, analysis, and data handling aspects of the remedial investigation. The plan shall be consistent with the requirements of EPA's Contract Laboratory Program. The plan shall address the following points:

1. QA Objectives for Measurement Data, in terms of precision, accuracy, completeness, representatives, and comparability.
2. Sampling Procedures.
3. Sample Custody.
4. Calibration Procedures, References, and Frequency.
5. Internal QC Checks and Frequency.
6. QA Performance Audits, System Audits, and Frequency.
7. QA Reports to Management.
8. Preventive Maintenance Procedures and Schedule.
9. Specific Procedures to be used to routinely assess data precision, representativeness, comparability, accuracy, and completeness of specific measurement parameters involved. This section will be required for all QA project plans.
10. Corrective Action.

The QA/QC plan must be approved by IEPA and USEPA prior to initiating any field activities.

FEASIBILITY STUDY
STATEMENT OF WORK

PURPOSE

The purpose of this remedial action feasibility study is to develop and evaluate remedial alternatives, and to identify the cost-effective remedial action to be taken with respect to conditions resulting from lead smelting and related activities in the Granite City, Illinois area. The Engineer shall furnish the necessary personnel, materials, and services required to prepare the remedial action feasibility study, except as otherwise specified herein.

SCOPE

The feasibility study consists of eight tasks:

Task 9 - Description of Proposed Response

Task 10 - Development of Alternatives

Task 11 - Initial Screening of Alternatives

Task 12 - Laboratory Studies

Task 13 - Evaluation of the Alternatives

Task 14 - Conceptual Design

Task 15 - Final Report

Task 16 - Additional Requirements

A work plan that includes a detailed technical approach, personnel qualifications and schedules shall be submitted to IEPA and USEPA for approval of the proposed feasibility study.

FEASIBILITY STUDY
WORK PLAN SCHEDULE

	TASK	Product	Target Completion Week for Tasks (*) and Products (**)	Personnel Work Hours
9	Description of Proposed Response		*, **	
10	Development of Alternatives	Preliminary Alternatives Submitted	*, **	
10-a	Response Objectives			
10-b	Identification of Remedial Alternatives			
11	Initial Screening of Alternatives		*, **	
12	Laboratory Studies [Optional]		*	
13	Evaluation of Alternatives		*	
13-a	Detailed Development of Remaining Alternatives			
13-b	Environmental Assessment	Environmental Information Document	**	
13-c	Cost Analysis			
13-d	Evaluation and Recommendation of Cost-Effective Alternative			
13-e	Report	Report	**	
14	Conceptual Design		*	
15	Final Report	Final Report	*, **	
16	Additional Requirements		*	

TASK 9--DESCRIPTION OF CURRENT SITUATION AND PROPOSED RESPONSE

A site-specific statement of the purpose for the response, based on the results of the remedial investigation will describe the discrete remedial technologies to be evaluated. This shall be submitted to IEPA and USEPA for approval and approved prior to commencement of Task 10.

TASK 10--DEVELOPMENT OF ALTERNATIVES

Based on the results of the remedial investigation and consideration of preliminary remedial technologies (Task 4), the Engineer shall develop a limited number of alternatives for source control or off-site remedial actions, or both.

a. Establishment of Remedial Response Objectives

Establish site-specific objectives for the response. These objectives shall be based on public health and environmental concerns, information gathered during the remedial investigation, Section 300.68 of the National Contingency Plan (NCP), EPA interim guidance, and the requirements of any other applicable Federal and State statutes. Preliminary cleanup objectives shall be developed in consultation with IEPA and USEPA.

b. Identification of Remedial Alternatives

Develop alternatives to incorporate remedial technologies (from Task 4b) response objectives, and other appropriate considerations into a comprehensive, site-specific approach. Alternatives should include non-cleanup (e.g., alternative water supply, relocation) and no-action options, if appropriate. The alternatives shall be developed in close consultation with IEPA and USEPA.

A range of contamination control alternatives shall be evaluated. These alternatives will be selected to reduce or control risks to the public which were identified and evaluated in the Phase I report. Alternatives must also reduce or prevent pollution to all environmental resources (air, land, surface and groundwater) from materials stored or handled on the Taracorp property or stored, deposited, or handled on adjacent property as a result of past lead processing activities at the smelting and fabricating plant and waste storage pile currently owned and operated by Taracorp.

The alternatives to being evaluated in Phase II must include, but are not limited to, the following, or combinations of the following control options:

1. Total removal of all lead waste and lead bearing waste materials and other hazardous waste materials from outside storage areas and underground tanks, i.e., removal to a hazardous waste site approved by IEPA and USEPA.

2. On-site reclaiming of salvageable lead and other materials, with interim control measures for storage piles during reclaiming and non-salvageable hazardous wastes removed to an approved off-site hazardous waste facility.

3. On-site reclaiming of salvageable lead and other materials with on-site burial of non-salvageable materials in properly constucted facilities approved by IEPA and USEPA.

4. On-site containment of the waste pile or part thereof, i.e., specially constructed groundwater barriers and suitable pile capping.

5. Removal and replacement of soils determined to contain excessive lead concentrations at the Taracorp plant site and on adjoining properties.

6. Removal and replacement of soils determined to contain excessive lead concentrations at residential, school, park and other public access areas.

7. Capping of lead-contaminated soils with clean soil, or other appropriate capping materials such as paving.

8. Planting of grass or other vegetative cover on lead-contaminated soil to minimize contact risk or airborne fugitive transport.

Submit to IEPA

TASK 11--INITIAL SCREENING OF ALTERNATIVES

The alternatives developed in previsous Tasks will be screened by the Engineer to eliminate alternatives that are clearly not feasible or appropriate. A report setting forth the results of this initial screening shall be sent to USEPA and IEPA for their approval prior to undertaking the detailed evaluations of the remaining alternatives called for in Task 13. The parties shall endeavor, prior to the commencement of Task 13, to identify for Task 13 evaluation the most promising alternatives, so as to reduce unnecessary evaluations.

Considerations to be Used in Initial Screening

Three broad considerations must be used as a basis for the initial screening: cost, effects of the alternative, and acceptable engineering practices. More specifically, the following factors must be considered:

1) Cost. An alternative whose cost far exceeds that of other alternatives will usually be eliminated. Total cost will include the cost of implementing the alternative and the cost of operation and maintenance.

2) Environmental effects. Alternatives posing significant adverse environmental effects will be excluded.

3) Environmental protection. Only those alternatives that satisfy the response objectives and contribute substantially to the protection of public health, welfare, or the environment shall be considered further. Source control alternatives shall achieve adequate control of source materials. Off-site alternatives shall minimize or mitigate the threat of harm to public health, welfare, or the environment.

4) Implementability and reliability. Alternatives that may prove extremely difficult to implement, will not achieve the remedial objectives in a reasonable time period, or rely on unproven technology will be eliminated.

TASK 12--LABORATORY STUDIES [If Required]

The Engineer shall conduct any necessary laboratory and bench scale treatability studies required to evaluate the effectiveness of remedial technologies and establish engineering criteria (e.g., leachate treatment; ground water treatment; compatability of waste/leachate with site barrier walls, cover, and other materials proposed for use in the remedy). It is expected that the scope of this task will depend on the results of Tasks 10 and 11 and therefore will not be complete at the start of Task 13. The Engineer will submit a separate work plan for any proposed laboratory studies for State approval. This submittal will be made in the timeframe required to maintain steady progress of the overall feasibility study. [Additional studies may also be conducted during the design phase of needed to refine treatability results or develop detailed design criteria.]

TASK 13--EVALUATION OF THE ALTERNATIVES

The Engineer shall evaluate the alternative remedies that pass through the initial screening in Task 11 and recommend the most desireable (cost effective) alternative to USEPA and the State.

Alternative evaluation shall be preceded by a detailed development of the remaining alternatives.

a. Detailed Development of Remaining Alternatives

The detailed development of the remaining feasible remedial alternatives shall include as a minimum;

1) Description of appropriate treatment and disposal technologies.

2) Special engineering considerations required to implement the alternative (e.g., pilot treatment facility, additional studies needed to proceed with final remedial design).

3) Environmental impacts and proposed methods, and costs, for mitigating any adverse effects.

4) Operation, maintenance, and monitoring requirements of the remedy.

5) Off-site disposal needs and transportation plans.

6) Temporary storage requirements.

7) Safety requirements for remedial implementation (including both on-site and off-site health and safety considerations).

8) A description of how the alternative could be phased into individual operable units. The description should include a discussion of how various operable units of the total remedy could be implemented individually or in groups, resulting in a significant improvement to the environment or savings in costs.

9) A review of any off-site disposal facilities to ensure compliance with applicable RCRA requirements.

b. Environmental Assessment

Perform an Environmental Assessment (EA) for each alternative. The EA shall include, at a minimum, an evaluation of each alternative's environmental effects, an analysis of measures to mitigate adverse effects, physical or legal constraints, and compliance with CERCLA or other regulatory requirements.

Each alternative will be assessed in terms of the extent to which it will mitigate damage to, or protect, public health, welfare, and the environment, in comparison to the other remedial alternatives. The specific considerations to be used in the assessment will be different for source control alternatives and for off-site alternatives, as explained in EPA guidance. Consideration may be given to standards and criteria developed under Federal or State environmental and health statutes.

c. Cost Analysis

Evaluate the cost of each feasible remedial action alternative (and for each phase or segment of the alternative). The cost will be presented as a present worth cost and will include the total cost of implementing the alternative and the annual operating and maintenance cost. A distribution of costs over time will be provided.

d. Evaluation and Recommendation of Cost-Effective Alternative

Alternatives shall be evaluated using technical, environmental, and economic criteria. At a minimum, the following areas will be used to evaluate alternatives:

1. Reliability. Alternatives that minimize or eliminate the potential for release of wastes into the environment will be considered more reliable than other alternatives.

2. Implementability. The requirements of implementing the alternatives will be considered, including phasing alternatives into operable units and segmenting alternatives into project areas on the site. The requirements for permits, zoning restrictions, right of ways and public acceptance are also examples of factors to be considered.

3. Operation and Maintenance Requirements. Preference will be given to projects with lower O&M requirements, other factors being equal.

4. Environmental Effects. Alternatives posing the least impact (or greatest improvement) on the environment will be favored.

5. Safety Requirements. On-site and off-site safety requirements during implementation of the alternatives should be considered. Alternatives with lower safety impact and cost will be favored.

6. Cost. The remedial alternative with the lowerst total present worth cost will be favored. Total present worth cost will include capital cost of implementing the alternative and cost of operations and maintenance of the proposed alternative.

Recommend the alternative determined to be the most cost-effective. The recommendation will be justified by stating the relative advantages over other alternatives considered. Evaluative considerations shall be applied uniformly to each alternative. The lowest cost alternative that is technologically feasible and reliable and that adequately protects (or mitigates damage to) public health, welfare, or the environment will be considered the cost-effective alternative.

e. Report

Prepare a report presenting the results of Tasks 9 through 13 and the recommended remedial alternative. Submit 5 copies each of the preliminary report to IEPA and USEPA for their review and comment. Following any changes made in this report by this review and comment, the report (as modified) will be presented by USEPA and IEPA for public hearing and comment. Following public hearing and comment, USEPA and IEPA will select a remedial alternative.

TASK 14--CONCEPTUAL DESIGN

Prepare a conceptual design of the remedial alternative selected by IEPA and USEPA. The conceptual design shall include, but is not limited to, the engineering approach including implementation schedule, special implementation requirements, institutional requirements, phasing and segmenting considerations, preliminary design criteria, preliminary site and facility layouts, budget cost estimate (including operation and maintenance costs), operating and maintenance requirements and duration, and an outline of the safety plan including cost impact on implementation. Any additional information required as the basis for the completion of the final remedial design will also be included. The Engineer may also be required to revise portions of the community relations plan to reflect the results of the conceptual design.

TASK 15--FINAL REPORT

Prepare a final report for submission to the State. The report shall include the results of Tasks 9 through 14, and should include any supplemental information in an appendix. Submit 5 copies each to IEPA and to USEPA.

The final report generated under Phase II will recommend the alternatives to be implemented for plant site and off-site clean up of contaminated areas. The report must contain a clear schedule for implementing and completing all phases of site clean-up actions and any necessary construction work. The report must be submitted to IEPA and USEPA for review. Alternatives to be implemented must be approved by IEPA and USEPA before any work is implemented.

TASK 16--ADDITIONAL REQUIREMENTS

Reporting requirements are described in Task 8 of the remedial investigation scope of work.

RC:jd/0160D/sp/1-22

Appendix B

GENERAL SAFETY PLAN

GRANITE CITY SITE

GRANITE CITY, ILLINOIS

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.
1304 BUCKLEY ROAD
SYRACUSE, NEW YORK 13221

TABLE OF CONTENTS

SECTION 1 - INTRODUCTION AND BACKGROUND INFORMATION

This document is the General Health and Safety Plan for site activities to be conducted during the Remedial Investigation/Feasibility Study (RI/FS) being performed on and in the vicinity of Granite City Site (also referred to as the Taracorp Site) in Granite City by O'Brien & Gere Engineers and associated subcontractors.

All personnel (here defined as employees of O'Brien & Gere Engineers, employees of all subcontractors, respondants, all visitors and representatives from the EPA, State, local groups, media, etc.) will be required to follow and adhere to the procedures set forth in this plan. All personnel will also be required to report to the Site Health and Safety Officer (SHSO) before proceeding on-site. All on-site work will be performed in accordance with applicable OSHA regulations incorporated in 29 CFR 1910 and 1926.

The RI/FS of the Site will involve operations conducted over several months duration which are addressed by this General Safety Plan. Safety procedures to be employed throughout the project will be in compliance with any applicable OSHA requirements.

1.01 Identification

Site Name: NL Industries - Granite City Site and Environs

Address/Location: 16th Street and Cleveland Boulevard
Granite City, Illinois

Project Description: Remedial Investigation/Feasibility Study (RI/FS)

On-Site Work Dates: 7 or 8 months following the date of approval of the Site Quality Assurance Project Plan (QAPP)

Overall Degree of Hazard: Low

1.02 Key Personnel for RI/FS

U.S. EPA Contact:	Brad Bradley (312) 886-4726
IEPA Springfield:	John G. Hooker (217) 782-6760
IEPA (Local) Contact:	Charles Reeter (618) 345-4606
Taracorp Contact:	George Webb (618) 451-4453
O'Brien & Gere Contact:	Frank D. Hale (315) 451-4700
Safety Coordinator:	Swiatoslav Kaczmar (315) 451-4700

1.03 Site Description

Type of Facility: Inactive secondary lead smelting site.

Size: Study area includes approximately 4 square miles of which 15.8 acres is defined as the site.

Buildings: Numerous (see Figure 1).

Surrounding Land Uses: Heavy industrial.

Layout: See Figure 1.

1.04 Site History

The Granite City Site has been used for secondary lead smelting since before 1905. At that time the facilities included a shot tower, machine shop, factory for the manufacturer of blackbird targets, sealing wax, manufacture of mixed metals, refining of drosses, and the rolling of sheet lead. Since that time, additional facilities have been added to provide secondary smelting capability. Figure 2 presents a Process Flow Diagram for the facilities existing prior to February 1983.

Since then the blast furnace and the rotary furnace have been shut down, limiting production to lead alloying and fabricating.

Historically, solid wastes generated during the manufacturing operations were stored on-site in the slag storage area as illustrated in Figure 3. Among the materials reportedly disposed of in this area are: slag, baghouse dust in 55-gallon drums, and battery cases. The nature of the disposal operations is such that the contents of the waste pile would not be expected to be homogeneous. Visual examination of the waste pile indicates that battery cases are confined to the upper areas; this supports NL Industries' understanding that battery recycling facilities were not installed until the middle 1950's.

There is some indication that shredded plastic and hard rubber from battery cases was collected by local contractors for use in driveway and alley paving.

Liquid wastes from the manufacturing operation are discharged via process sewers to the municipal sewer system. Granite City utilizes combined sewers running under the Granite City Site to transport wastewater to treatment facilities.

Previous studies which have assessed conditions at the Granite City Site include an April 1983 report published by Illinois Environmental Protection Agency. In addition, the site was reviewed as part of the State Implementation Plan for the State of Illinois, and published in September 1983.

1.05 Summary of Site Hazards

The Granite City Site of the Taracorp Company, as well as surrounding areas, have been determined to represent the following potential hazards:

- soil and groundwater samples indicate the presence of several heavy metals, most notably lead (Pb).

- the uncovered waste pile presents the potential of both run-on and run-off of the materials mentioned above, as well as waste acid.

1.06 Project Description and Purpose

The Remedial Investigation (RI) will include those activities (sampling, monitoring well installation, geophysical studies, etc.) necessary to determine the nature, extent and concentration of on-site wastes and environmental contaminants. In addition, off-site soil lead contamination will be evaluated. Field activities will primarily be conducted during the RI.

The Feasibility Study (FS) will identify and evaluate the appropriate remedial actions for the site, based on existing data and information gathered during the RI. This work phase is primarily engineering design evaluation and is to be conducted off-site.

SECTION 2 - HAZARD EVALUATION

2.01 Previous Monitoring Performed On-Site

Several studies of the site have been conducted, both prior to and after the shutdown of the smelting operation. This Safety Plan is concerned only with conditions of the site currently since the shutdown of the operations.

In July, 1983, the IEPA conducted groundwater monitoring. Soil profiles, soil analysis and groundwater analysis were obtained from eight well sites. The following metals were found to be present at concentrations higher than generally established background:

Antimony	Iron	Nickel
Arsenic	Lead	Selenium
Cadmium	Manganese	Silver
Copper	Mercury	Zinc

In September, 1983, the Illinois State Implementation Plan alleged the presence of caustic soda (sodium hydroxide) in drums on the waste site, powdered metals and various lead waste on the waste pile, as well as environmental lead contamination. The site encompassed a 3 acre waste pile with 200,000 tons of lead waste.

An April, 1984 report documented groundwater and airborn (dust) lead contamination. Corroded, crushed drums in the waste pile were analyzed for heavy metals. The results include elevated concentration of:

Cadmium
Copper
Lead
Selenium
Zinc

The above discussion of previous monitoring schemes is intended as an overview, and is not to be considered as a complete record of all analytical/monitoring work prior to O'Brien & Gere's involvement with the project.

2.02 Previous Levels of Personnel Protection

No information is available on specific safety precautions and/or personnel protection levels utilized (in prior investigations) on the Granite City Site.

2.03 Hazardous Materials Known to be On-Site

The hazardous materials potentially on the Granite City site are:

Antimony	Mercury
Arsenic	Nickel
Cadmium	Nitric Acid

Copper	Selenium
Iron	Silver
Lead	Sodium Hydroxide
	Sulfuric Acid
Manganese	Zinc

2.04 Overall Degree of Hazard

Low to Moderate
Respiratory Protection (RP)
Level C-RP protection will be required during all on-site activities in designated contamination zones. Required protective equipment may be downgraded to Level D for off-site sampling activities.

2.05 Specific Hazards

Routes of exposure of site workers to the previously mentioned hazardous components include all of the following:

- direct contact via skin, eyes, or mouth
- inspiration of heavy metal dust

The specific hazardous of the materials are briefly described below:

1. Lead - Lead is a toxin in elevated levels, having a detrimental affect on nervous system, kidney, blood and bone marrow. Major routes for absorption are consumption and inspiration.

2. Other heavy metals - Each as "directed" affect on target organ(s), similar to lead. In all cases, the level of hazard correlates to the level of exposure.

Thus, the minimization (and ultimately the elimination) of exposures via an effective Safety Plan is highly stressed.

2.06 Respiratory Protection (RP) Action Levels

Level D - (no respiratory protection necessary) is expected to be used during most off-site soil sampling and some activities on the site.

Level C-RP - Air purifying respirator (half-face respirator), high efficiency particulate filter cartridge will be available to all site personnel who have been fit-tested. Level C-RP will be required during waste characterization sampling because of the possibility of conditions which could result in a moderate, sudden release of dust.

2.07 Contact Protection

General dress requirements (minimum requirements for Level C, D) for work on-site are:

1. Rubber safety boots or safety work boots with rubber over boots (C & D).
2. Cotton coverall (D) or work clothing under white Tyvek^{R} suit (C).
3. Tyvek^{R} or other hood (C).
4. Cotton gloves (D) or surgeon's gloves and rubber over gloves (C).
5. Protective eyewear.
6. Hard hats.

The dress requirements for off-site soil sampling considered appropriate for Level D protection will be:

1. Safety work boots.
2. Cotton coverall.
3. Protective eyewear.
4. Cotton gloves.

SECTION 3 - PROTOCOLS FOR ROUTINE ACTIVITIES

3.01 Health and Safety Management and Responsibilities

Site Health and Safety Officer (SHSO) -

Dr. Kaczmar has responsibility for the safety of operations and Health and Safety of all contractor personnel. Following an initial safety reconnaissance Dr. Kaczmar may designate an on-site representative to institute required procedures.

Subcontractors and Government Oversight Personnel -

All subcontractors are required to adhere to the requirements of this General Health and Safety Plan and related Task Specific Health and Safety Plans. They may upgrade their level of personal protection where necessary in order to comply with their own corporate Health and Safety requirements.

During performance of large tasks, subcontractors may wish to designate one of their trained personnel as a Safety Officer. This person must coordinate actions with the Site HSO or OSC. It is recognized that all subcontracted Safety Officers are subordinate to the OSC and HSO as designated above.

3.02 General Requirements for Entry in Contaminated Zones

Before proceeding onto the site past the Entry and Exit Point, all O'Brien & Gere and subcontractor personnel shall:

1. Be advised of the Health and Safety Plan, instructed in safety procedures and aware of potential hazards.
2. Be properly dressed and equipped.
3. Notify the SHSO or his or her designated representative.

All personnel entering into areas or performing Tasks requiring Level C respiratory protection shall:

1. Have been fit tested and have medical approval.
2. Be clean shaven in areas where the mask touches the face.
3. Have had necessary respiratory training.
4. Work in a minimum of 2 person team with a line-of-sight or radio communication with a third person.

3.03 Site Entry and Exit (E&E) Procedures

Entry procedures are as follows:

1. Personnel dressout and activate necessary monitoring equipment.

2. All personnel (or team/Task leader) notify the SHSO of intended operations.

3. SHSO reviews team personnel with respect to Section 3.02 above.

4. Entry time and personnel are logged.

5. Team proceeds through the designated, controlled E&E point (entry and exit).

Exit procedures are:

1. All personnel exit through the designated E&E point.

2. All personnel go through appropriate decontamination. (See Attachment 2)

3. All personnel are logged out and time recorded.

3.04 Daily Start-up and Shut-down Procedures

Start-up procedures are:

1. SHSO reviews site conditions with respect to modifications of work and safety plans.

2. Personnel and team briefing, review and update of safety procedures.

3. Check out of safety and monitoring equipment.

4. SHSO ensures that first aid station is operable.

5. SHSO initiates appropriate monitoring.

6. Team dress out, proceed to Tasks.

Shut-down procedures are:

1. All personnel exit and decontaminate.

2. SHSO logs all personnel out.

3. When appropriate, the SHSO performs a site walk to ensure that all personnel are off site and that the site is secure.

4. Equipment and site are secured.

3.05 Action Levels/General Personnel Protection Guidelines

Dress requirements may vary from Task to Task. Minimum dress requirements are outlined in Section 2.07. Respiratory protection requirements are outlined in Section 2.06.

1. Level C (full-face respirator, high efficiency organic vapor/particulate/pesticide cartridge) Action Levels

   Level C will be required during performance of Tasks in designated Hot Zones or as designated in the Task Specific Health and Safety Plans.

2. Level D (no respiratory protection):

   Level D will be allowed in contaminated zones not requiring respiratory protection as outlined above, and in support and clean areas.

3.06 Heat/Cold Stress

During weather above 70°, or any conditions of excessive humidity, workers will be routinely observed for symptoms of heat stress. Heat stress will be prevented by periodic breaks and the availability of air fans and cold fluids. At cold temperatures (below 40°F) workers will be required to wear adequate warm, dry clothing.

3.07 Decontamination Procedures

Personnel

Necessary personnel decontamination will be outlined in the Task Specific Safety Plans, in accordance with accepted procedures. As a minimum, all personnel entering Hot or Contaminated Zones will go through the following decontamination upon exiting:

1. Boot wash (detergent or water)
2. Boot rinse (water)
3. Outer glove wash (detergent and water)
4. Outer glove rinse
5. Removal of boots, tyveks and then gloves.

All personnel shall be free of visible contamination prior to leaving the site.

Sample Containers

After obtaining the sample, all containers will be decontaminated with a detergent/water wash and water rinse.

Sampling Equipment

All reusable sampling equipment (bailers, buckets, augers, split spoons, etc.) will undergo the following decontamination prior to initial use on site, between each use, and upon final use. Equipment shall be cleaned of all visible contamination.

1. Thorough detergent/water rinse.
2. Tap water rinse.

After decontaminating, sample equipment shall be placed in clean plastic bags or other suitable wrapping to prevent recontamination. Wash and rinse water will be containerized for proper disposal.

Geotechnical Apparatus

All technical/geotechnical apparatus such as augers, rods, drill bits, casings, etc., and backhoe buckets (where used to excavate test pits for sampling) will undergo the following decontamination prior to use on-site, between each use on-site, and prior to removal from the site to remove all visible contamination and soils:

1. High pressure hot water wash and/or steam cleaning (steam genny).

Heavy Equipment

All trucks, drill rigs, backhoes, or other equipment will undergo decontamination prior to leaving the site. The decon, as a minimum will require a cleaning of tires and treads to remove all visible muck, soils and contamination.

SECTION 4 - EMERGENCY INFORMATION

4.01 Emergency Telephone Numbers

State Police: (618) 345-1212 (in Collinsville)
Fire Department: (618) 876-4545
City Ambulance Service: (618) 876-4545
Hospital: (618) 798-3000
Poison Control Center: (618) 798-3066

° State your name, location and nature of emergency
° For Hospital Victim:
-Name and phone of family or emergency physician.
-Description of incident - chemicals involved, symptoms, nature of injury, proposed treatment, plan of transportation.

4.02 Directions to Hospital

16th Street Northwest to Madison (left out of 16th Street parking lot); turn left onto Madison; hospital is 4 blocks up on Madison.

4.03 Procedures for Serious Injury/Exposure

1. Perform necessary emergency first aid or treatment.
2. Evacuate all personnel from area if dangerous.
3. Notify SHSO.
4. Call appropriate emergency support.
5. Perform secondary first aid and prepare victim for transport.
6. Evacuate victim to hospital.
7. Notify hospital of the incoming patient and type/severity of injury and exposure.

4.04 Procedures for Fire

1. Isolate the location of the fire and alert on-site personnel.
2. If possible, contain the fire. A fire extinguisher will be available at the entry and exit point.
3. Notify the fire department.
4. Evacuate the immediate area if fire cannot be contained.

4.05 Contingency Plan

Signal - 5 one second blasts of auto or air horn.
Action - All personnel immediately evacuate downrange areas and report to the site access point/decon line for instruction.

SECTION 5 - FIRST AID FOR EXPOSURE

The following is a general description of first aid measures to be employed on site. In all cases of symptoms of chemical exposure, first aid treatment is to be followed by full medical examination.

5.01 Inhalation

Symptoms: dizziness, nausea, lack of coordination, headache, irregular rapid breathing, weakness, loss of consciousness, coma.

Treatment:
1. Bring victim to fresh air. Rinse eyes or throat if irritated.
2. If severe (victim vomits, is very dizzy or groggy, etc.) evacuate to a hospital.
3. Be prepared to administer CPR.
4. Evacuate victim to hospital.

5.02 Dermal

Symptoms: Same as above. With phenol the affected area is typically white, wrinkled and softened with no pain (may also be reddened). Solvents may product irritation, rash, or burning.

Treatment:
1. Flush affected area with water for 5 minutes.
2. Cover with a clean dressing.
3. If phenol is suspected or CNS symptoms develop, evacuate victim to hospital.
4. Monitor victim for at least 48 hours.

5.03 Ingestion

Symptoms: Same as above, with stomach cramps.

Treatment:
1. Evacuate victim to hospital.
2. If any sign of burns are obvious, do <u>not</u> induce vomiting.

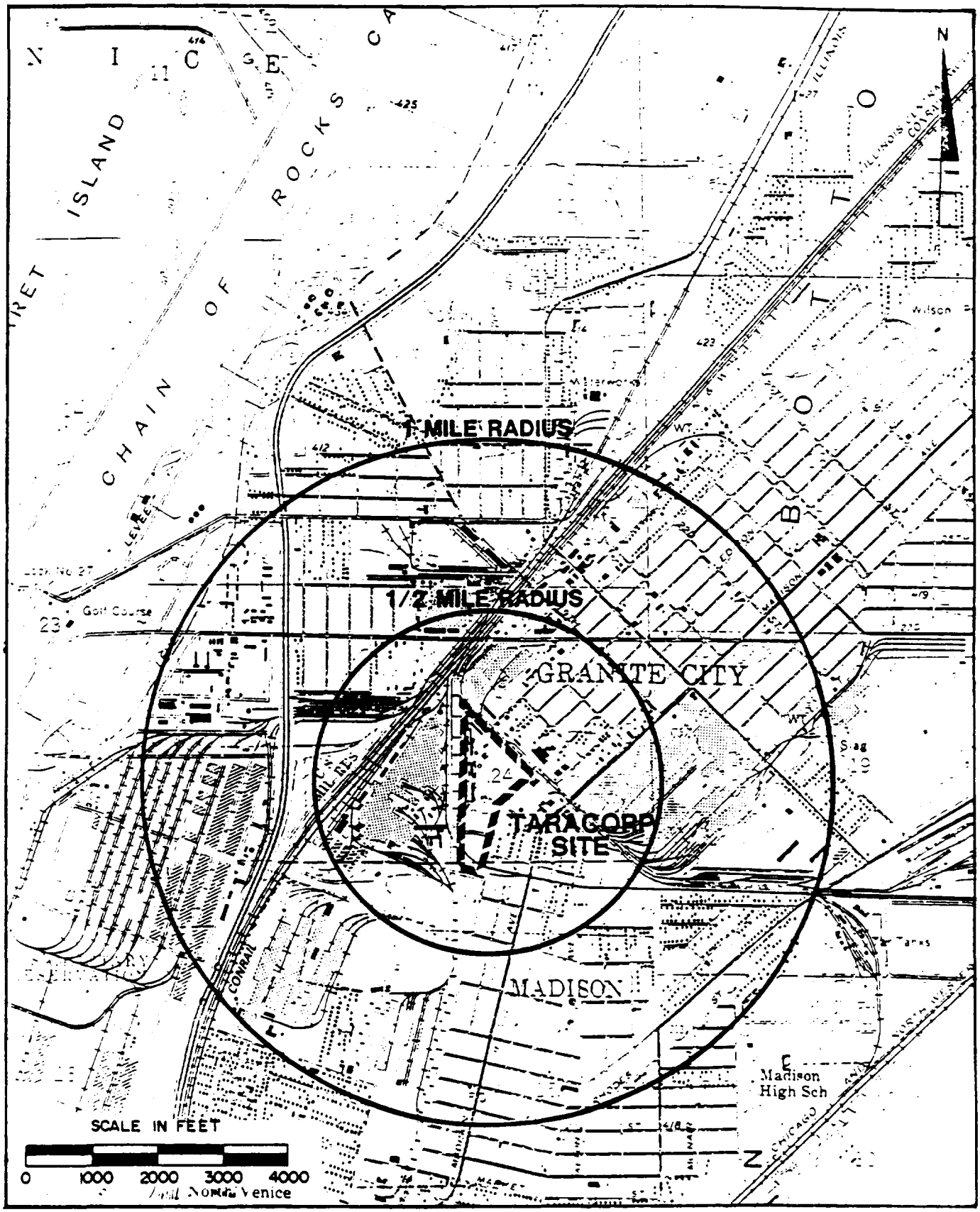
5.04 Eye Contact

Symptoms: Redness, irritation, pain, impaired vision.

Treatment:
1. Flush with water for at least 5 minutes using a portable eyewash unit.
2. If severe, evacuate victim to a hospital.

FIGURE B-1

LOCATION MAP



PROCESS FLOW DIAGRAM FOR TARACORP SECONDARY LEAD SMELTER

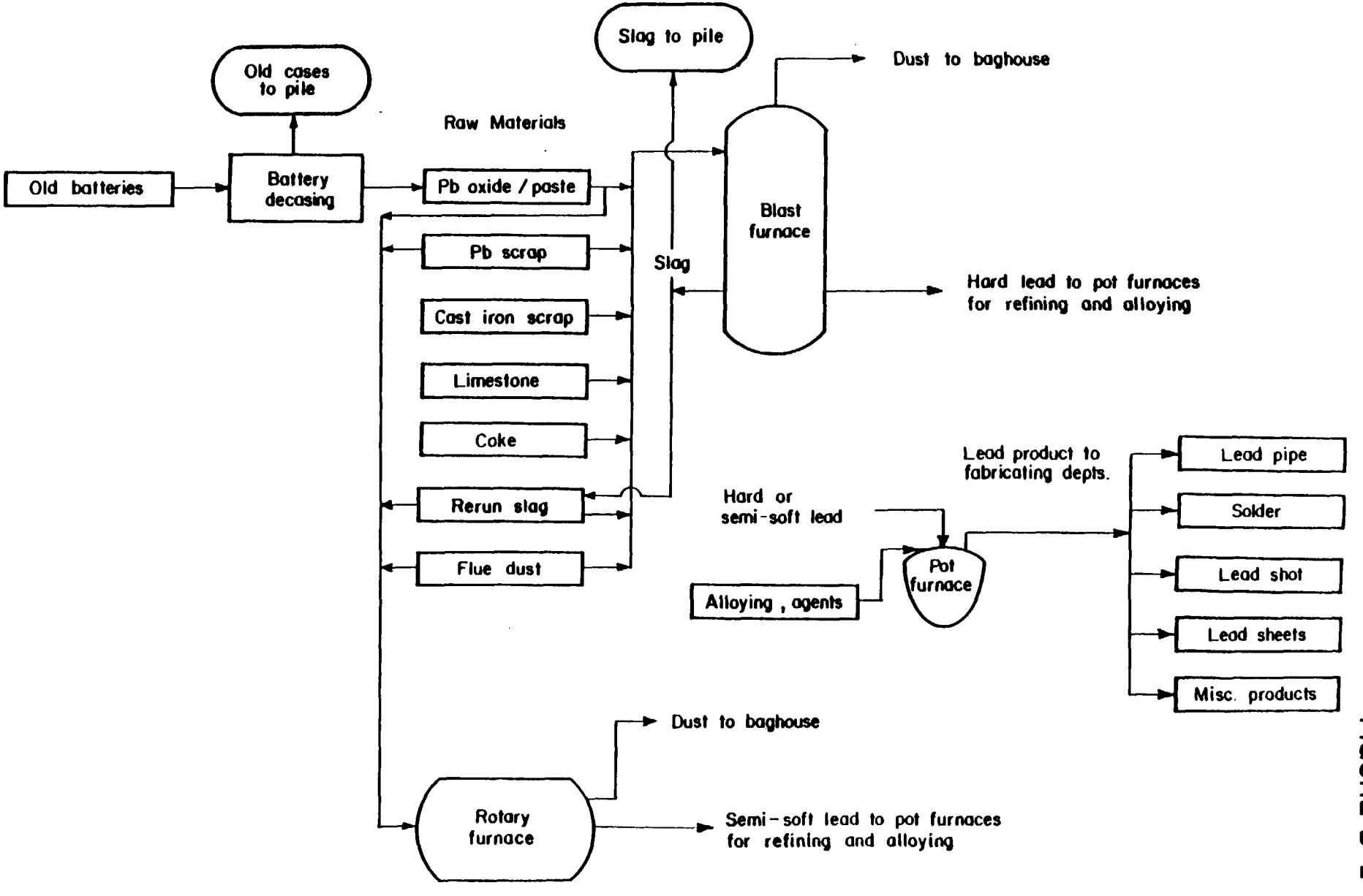
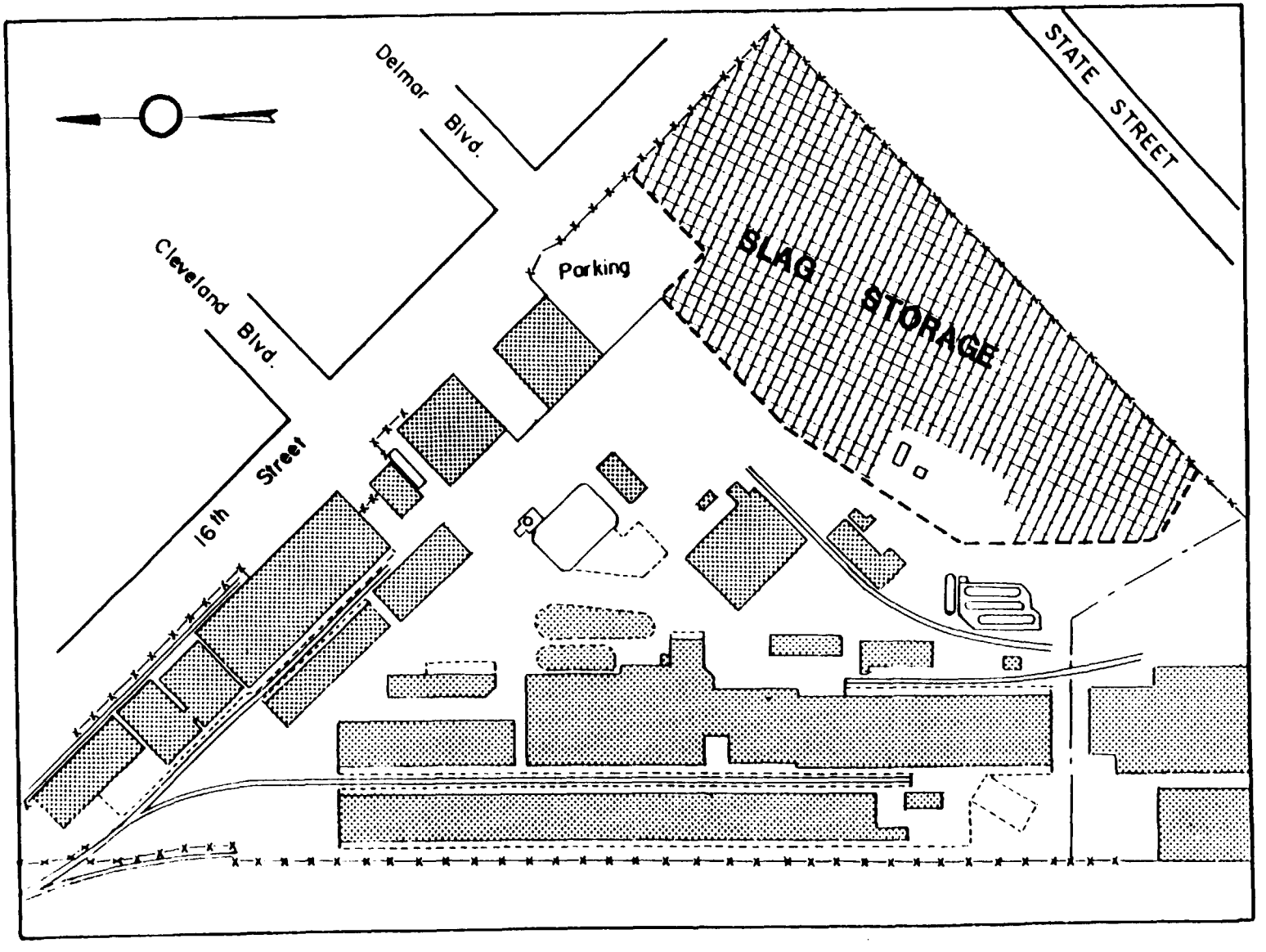


FIGURE B-2



TARACORP SITE PLAN

Scale

1" = 160'

160 80 0 80 160

FEET

FIGURE B-3

ATTACHMENT B-1

LEVELS OF PERSONNEL PROTECTION

ATTACHMENT B-1

LEVELS OF PERSONNEL PROTECTION

LEVEL A protection should be worn when the highest level of respiratory, skin, eye, and mucous membrane protection is needed. Level A will probably not be required at this site.

- Positive-pressure (pressure demand), self-contained, breathing apparatus (OSHA/NIOSH approved) (REQUIRED).
- Fully-encapsulating, chemical-resistant suit (REQUIRED).
- Chemical resistant inner and outer gloves (REQUIRED).
- Chemical resistant boots with steel toe and shank; depending on suit boot construction, worn over or under suit boot. (REQUIRED).
- Thermal Luminescent Detector (TLD) Badge for Radiation.
- Personal radiation detector.
- Hard hat (under suit).
- Coveralls (under suit).
- Two-way radio communications (intrinsically safe) (REQUIRED).

LEVEL B protection should be selected when the highest level of respiratory protection is needed, but a lesser level of skin and eye protection. Level B protection is the minimum level recommended on initial site entries until hazards have been further identified and defined by monitoring, sampling, and other reliable methods of analysis. Personnel equipment corresponding with those findings may then be utilized. It is anticipated that Level B protection will not be required at this site.

- Positive-pressure (pressure-demand), self-contained, breathing apparatus (OSHA/NIOSH approved) (REQUIRED).
- Chemical-resistant clothing (overalls and long sleeved jacket, coveralls, hooded, two-piece, chemical splash suit, or disposable chemical-resistant coveralls) (REQUIRED).
- Coveralls (under splash suit).
- (TLD) Badge for Radiation.
- Personal radiation detector.
- Chemical resistant inner and outer gloves (REQUIRED).
- Chemical resistant boots with steel toe and shank (REQUIRED).
- Two-way radio communications (intrinsically safe).
- Hard hat.

LEVEL C protection should be selected when the type of hazardous airborn substance is known, concentration measured, criteria for using air-purifying respirators met, and skin and eye exposure is unlikely. Monitoring of the air must be performed to comply with OSHA regulations and ensure respiratory effectiveness. This level of protection will be required at this site when sampling the slag pile and St. Louis Lead Recyclers Pile.

- Full-face, air-purifying respirator (OSHA/NIOSH approved) with cartridge type GMC-H (REQUIRED).
- Chemical-resistant clothing (one-piece coverall, hooded, two-piece, chemical-splash suit, chemical resistant hood and apron, disposable chemical resistant coveralls) (REQUIRED).
- Chemical resistant inner and outer gloves (REQUIRED).
- Boots, steel toe and shank, chemical-resistant (REQUIRED).
- Two-way communications (intrinsically safe).
- Hard hat.
- Escape mask.

LEVEL D is primarily a work uniform. It should not be worn on any site where respiratory or skin hazards exist. This level provides adequate protection for work on the Granite City Site, except those specific tasks noted for Level C above.

- Protective coveralls and protective gloves.
- Boots or shoe with steel toe and shank (REQUIRED).
- Hard hat.
- Safety eye wear (REQUIRED).

ATTACHMENT B-2

LEVEL D - DECONTAMINATION PROTOCOL

ATTACHMENT B-2

LEVEL D - DECONTAMINATION PROTOCOL

A. Equipment Worn

The full decontamination procedure outlined is for workers wearing Level D Protection with taped joints between gloves, boots, and suits. The full set of protective equipment is designed for use in designated hot zones. Activities taking place outside the designated hot zones may justify a lower level of personnel protection.

Coveralls and protective gloves
Hard hat, as required
Steel toe and shank boots or shoes
Eye protection, as required
Inner or outer gloves, as required
Boot covers, as required

B. Procedure for Full Decontamination

Station 1: Segregated Equipment Drop

Deposit equipment (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on drop cloths or in different waste containers with plastic liners. Segregation at the drop reduces the probability of cross-contamination.

Equipment: Various size plastic lined waste containers
Plastic drop cloths

Station 2: Boot Cover and Glove Wash, as Required.

Scrub boots and gloves with decontamination solution or detergent/water mixture.

Equipment: Container
Decon solution or detergent/water mixture
2-3 Long-handle, soft-bristle scrub brushes

Station 3: Boot Cover and Glove Rinse, as Required.

Rinse off decontamination solution from Station 2 using copious amounts of water. Repeat as many times as necessary.

Equipment: Container
Water spray unit
2-3 Long-handle, soft-bristle scrub brushes

Station 4: Tape Removal, as Required

Remove tape around boots and gloves and deposit in waste container.

Equipment: Waste container

Station 5: Boot Cover Removal, as Required

Remove boot covers and deposit in waste container.

Equipment: Waste container
Bench or stool

Station 6: Outer Glove Removal, as Required

Remove outer gloves and deposit in waste container.

Equipment: Waste container

Station 7: Coveralls Removal

With assistance of helper, remove coveralls. Deposit in waste container. Launder separately from other clothing.

Equipment: Waste container
Bench or stool

Station 8: Inner Glove Wash, as Required

Wash inner gloves with decontamination solution or detergent/water mixture that will not harm skin. Repeat as many times as necessary.

Equipment: Decon solution or Detergent/water mixture
Basin or bucket

Station 9: Inner Glove Rinse, as Required

Rinse inner gloves with water. Repeat as many times as necessary.

Equipment: Water
Basin or bucket
Small table

Station 10: Inner Glove Removal

Remove inner gloves and deposit in waste container.

Equipment: Waste container

Station 11: Field Wash

Wash hands and face.

Equipment:
- Water
- Soap
- Tables
- Wash basins/buckets

Station 12: Redress, as Required.

Put on clean clothes. A dressing trailer can be used in inclement weather.

Equipment:
- Tables
- Chairs
- Clothes

ATTACHMENT B-3

LEVEL C - DECONTAMINATION PROCEDURES

ATTACHMENT B-3

LEVEL C DECONTAMINATION PROCEDURES

A. Equipment Worn

The full decontamination procedure outlined is for workers wearing Level C protection (with taped joints between gloves, boots, and suit) consisting of:

One-piece, hooded, chemical-resistant splash suit.
Canister equipped, full-face mask.
Hard hat.
Chemical-resistant, steel toe and shank boots.
Boot covers.
Inner and outer gloves.

B. Procedure for Full Decontamination

Station 1: Segregated Equipment Drop

Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination.

Equipment: Various size containers
Plastic liners
Plastic drop cloths

Station 2: Boot Cover and Glove Wash

Scrub outer boot covers and gloves with decontamination solution or detergent/water mixture.

Equipment: Container (20-30 gallons)
Decontamination solution or detergent/water mixture
2-3 long-handle, soft-bristle scrub brushes

Station 3: Boot Cover and Glove Rinse

Rinse off decontamination solution from Station 2 using copious amounts of water. Repeat as many times as necessary.

Equipment: Container (30-50 gallons) or high-pressure spray unit
Water
2-3 long-handle, soft-bristle scrub brushes

Station 4: Tape Removal

Remove tape around boots and gloves and deposit in container with plastic liner.

Equipment: Container (20-30 gallons)
Plastic liners

Station 5: Boot Cover Removal

Remove boot covers and deposit in container with plastic liner.

Equipment: Container (30-50 gallons)
Plastic liners
Bench or stool

Station 6: Outer Glove Removal

Remove outer gloves and deposit in container with plastic liner.

Equipment: Container (20-30 gallons)
Plastic liners

Station 7: Suit/Safety Boot Wash

Thoroughly wash splash suit and safety boots. Scrub with long-handle, soft-bristle scrub brush and copious amounts of decontamination solution or detergent/water mixture. Repeat as many times as necessary.

Equipment: Container (30-50 gallons)
Decontamination solution or detergent/water mixture
2-3 long-handle, soft-bristle scrub brushes

Station 8: Suit/Safety Boot Rinse

Rinse off decontamination solution or detergent/water mixture using copious amounts of water. Repeat as many times as necessary.

Equipment: Container (30-50 gallons) or high-pressure spray unit
Water
2-3 long-handle, soft-bristle scrub brushes

Station 9: Canister or Mask Change

If worker leaves Exclusion Zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boots covers donned, and joints taped. Worker returns to duty.

Equipment: Canister (or mask)
Tape
Boot covers
Gloves

Station 10: Safety Boot Removal

Remove safety boots and deposit in container with plastic liner.

Equipment: Container (30-50 gallons)
Plastic liners
Bench or stool
Boot jack

Station 11: Splash Suit Removal

With assistance of helper, remove splash suit. Deposit in container with plastic liner.

Equipment: Container (30-50 gallons)
Bench or stool
Plastic liner

Station 12: Inner Glove Wash

Wash inner gloves with decontamination solution or detergent/water mixture that will not harm skin. Repeat as many times as necessary.

Equipment: Decontamination solution or detergent/water mixture
Basin or bucket

Station 13: Inner Glove Rinse

Rinse inner gloves with water. Repeat as many times as necessary.

Equipment: Water
Basin or bucket
Small table

Station 14: Facepiece Removal

Remove facepiece. Avoid touching face with gloves. Deposit facepiece in container with plastic liner.

Equipment: Container (30-50 gallons)
Plastic liners

Station 15: Inner Glove Removal

Remove inner gloves and deposit in container with plastic liner.

Equipment: Container (20-30 gallons)
Plastic liners

Station 16: Inner Clothing Removal

Remove clothing soaked with perspiration. Place in container with plastic liner. Do not wear inner clothing off-site since there is a possibility small amounts of contaminants might have been transferred in removing fully encapsulating suit.

Equipment: Container (30-50 gallons)
Plastic liners

Station 17: Field Wash

Shower if highly toxic, skin-corrosive or skin-adsorbable materials are known or suspected to be present. Wash hands and face if shower is not available.

Equipment: Water
Soap
Tables
Wash basins/buckets
Field showers

Station 18: Redress

Put on clean clothes. A dressing trailer is needed in inclement weather.

Equipment: Tables
Chairs
Lockers
Clothes

Appendix C

O'BRIEN & GERE

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN (QAPP)

GRANITE CITY SITE

GRANITE CITY, ILLINOIS

APPROVALS:

USEPA REGION V
REMEDIAL PROJECT MANAGER

Date: _____

USEPA REGION V
QUALITY ASSURANCE OFFICER

Date: _____

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY
REMEDIAL PROJECT MANAGER

Date: _____

ILLINOIS ENVIRONMENTAL
PROTECTION AGENCY
QUALITY ASSURANCE OFFICER

Date: _____

O'BRIEN & GERE ENGINEERS, INC.
PROJECT OFFICER

C B Murphy Jr
Date: 6/26/86

OBG LABORATORIES, INC.
QUALITY ASSURANCE OFFICER

Daniel C. [illegible]
Date: 6/26/86

PREPARED BY:

O'BRIEN & GERE ENGINEERS, INC.
1304 BUCKLEY ROAD
SYRACUSE, NEW YORK 13221

TABLE OF CONTENTS

INTRODUCTION

Environmental Protection Agency (EPA) policy requires implementation of a quality assurance/quality control (QA/QC) program for all hazardous waste investigations. This requirement applies to all environmental monitoring and measurement mandated or supported by EPA.

Each investigator generating data must implement minimum procedures to assure that the precision, accuracy, completeness, and representativeness of the data are known and documented. In addition, the investigator should specify the acceptable quality levels that data must meet. To ensure that this responsibility is met uniformly, each investigator must have a written QA Project Plan (QAPP) covering each project that is investigated. The QA/QC activities shall be carried out in accordance with EPA, state and local government mandates.

This QAPP has been prepared by O'Brien & Gere Engineers for the Granite City Site. It is in the format specified in EPA document QAMS-005/80 entitled "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans." The QAPP presents, in specific terms, the policies, organization, objectives, functional activities, and specific QA/QC activities designed to achieve the data quality goals of the specific project.

PROJECT DESCRIPTION

The remedial investigation/feasibility study (RI/FS) for the Granite City Site is intended to determine the nature and extent of the conditions resulting from lead smelting and related activities on the site, to develop and evaluate remedial response actions, and to recommend the most cost-effective, technically feasible alternatives which reduce impacts on human health, welfare and the environment to an acceptable level, pursuant with the National Contingency Plan. Finally, the RI/FS will include a conceptual design of the remedial response action alternative(s) selected by the USEPA and the Illinois EPA (IEPA). To accomplish these objectives, the following general tasks must be completed:

- Characterize the waste, soil, groundwater, sediment, surface water, and drummed materials for the presence of heavy metals.
- Identify pathways of chemical migration from the site.
- Characterize the offsite soil for the presence of lead.
- Identify specific waste components with a potential for posing hazards to public health.
- Determine and describe onsite physical features that could affect migration of key waste components, methods of containment, or methods of remedial action cleanup.
- Develop viable remedial action alternatives.

- Permit the evaluation of the remedial action alternatives.

- Recommend the most cost-effective, technically feasible remedial option which has the ability to reduce impacts on human health, welfare and the environment to an acceptable level.

- Prepare a conceptual design of the recommended remedial action alternative.

PROJECT ORGANIZATION

Attachment C-1 lists the primary contacts for the project. Project technical personnel and quality assurance personnel are indicated in the project organization chart (Attachment C-2).

Primary responsibility for project quality review rests in the O'Brien & Gere site project manager. Independent quality assurance review is provided by the NL Project Manager, the Program Managers, and the EPA Technical Oversight Manager.

Where quality assurance problems or deficiencies requiring special action are uncovered, the Program Managers, Project Manager and Technical Advisory Committee will identify the appropriate corrective action to be initiated by the NL Industries project manager.

QUALITY ASSURANCE OBJECTIVES

The general quality assurance objective for analyzed measurement data is to ensure that environmental monitoring data of known and acceptable quality are provided.

For this project, the specific objectives for measurement data in terms of precision, accuracy and compatibility are the same as the objectives established for the Statement of Work for the U.S. EPA Contract Laboratory Program (CLP) for inorganics dated May 18, 1982. The specific methods for establishing objectives for measurement data, in terms of completeness and representativeness, are those established for the individual sampling tests described in the sampling plan appended to this QAPP. Tables C-1 and C-2 present specific QA Objectives to be employed during the implementation of this project.

SAMPLING PROCEDURES

The objective of sampling procedures is to obtain samples that represent the environmental matrix being investigated. Trace levels of contaminants from external sources will be eliminated through the use of good sampling techniques and proper selection of sampling equipment.

Sampling of water, sediments, soils, and wastes is required. A detailed sampling plan has been developed for each field sampling program and is appended to the QAPP. Source material used in developing the sampling plan included the following:

Technical Support Documents

- Samplers and Sampling Procedures for Hazardous Waste Streams (EPA-600/2-80-180)
- Test Methods for Evaluating Solid Wastes (EPA SW 846-1980)
- User's Guide to the EPA Contract Laboratory Program
- EPA Technical Monographs
  - 15--Purposes and Objectives of Sampling
  - 16--Water Sampling Methods
  - 17--Soil and Sediment Sampling Methods
  - 18--Sampling of Biological Specimens
  - 19--Methods of Collecting Concentrated (Hazardous) Samples
  - 20--Container Opening Techniques
  - 22--Sample Handling, Packaging, and Shipping Procedures

The Sampling Plan (Appendix D) includes the following protocols and documentation.

- Number of locations to be sampled.
- Sampling procedures to be used at the site.
- Tests to be completed at each site.
- Sampling equipment required at the site.
- Sample containers required at the site.
- Preservation methods to be used at the site for various types of samples.
- Reagents, etc., required at the site for sample preservation.
- Shipping containers at the site.
- Chain-of-custody procedures to be used at the site.
- Shipping methods and destinations, marking instructions, special labels, etc.

SAMPLE CUSTODY

Sample custody procedures for this project, including those employed in the field and laboratory, will be in strict conformance with the procedures detailed in NEIC Policies and Procedures (EPA-330/9-78-001-R, Revised June 1985). These procedures were established to comply with EPA requirements for sample control.

All samples collected for analysis will be taken by chemists, physical science technicians, or other qualified personnel designated by O'Brien & Gere with specific instructions from the Project Manager. All samples will be placed in the custody of the analytical chemist responsible for the analysis. The sample information will be recorded on the same report sheets if analyzed immediately. Stored samples (including archive portions) will be cataloged and stored appropriately for future analysis. The record of samples cataloged and stored may be audited by the QA Officer.

Final Evidence Files will also be developed and maintained in accordance with the above-referenced NEIC Policies and Procedures.

EQUIPMENT CALIBRATION

All field equipment used during this project will be calibrated and operated according to manufacturer's instructions. Any field equipment used during this project that is not covered by the investigator's standard operating procedures will have a specific calibration and operation instruction sheet prepared for it. The specific instruction sheet(s) are on file with the analytical laboratory.

The following protocols are further documented in the Laboratory QA/QC manual (Attachment C-3).

A. General

1. Each major piece of analytical laboratory instrumentation used on this project is documented and on file with the analytical laboratory.

2. A form is prepared for each new purchase and all forms will be discarded when the instrument is replaced.

B. Testing

1. Each form details both preventative maintenance activities and the required QA testing and monitoring.

2. In the event the instrument does not perform within the limits specified on the monitoring form, the Laboratory Manager will be notified and a decision made as to what action to take.

3. If repair is deemed necessary, an "out of order" sign will be placed in the instrument until repairs are effected.

C. Records

1. A bound notebook is kept with each instrument to record all activities related to maintenance, QA monitoring, and repairs.

2. These records will be checked during periodic equipment review.

ANALYTICAL PROCEDURES

All samples collected during this project will be delivered to O'Brien & Gere's laboratory for analysis for the appropriately selected parameters in accordance with the standard analytical procedures established by the EPA for the Contract Laboratory Program.

Samples of solids including soil, sediment, and lead slag will be digested utilizing the procedures outlined in Tables C-1 and C-2, and Attachment C-3.

Groundwater samples will be filtered (through 0.45 micron filter) and acidified in the field. Surface runoff samples will be collected but not filtered. The water samples will be analyzed for metals utilizing the procedures outlined in Tables C-1 and C-2, and Attachment C-3. The samples of drummed materials will also be analyzed for metals pursuant to the procedures outlined in Tables C-1 and C-2, and discussed in Attachment C-3.

DATA ANALYSIS

All raw data collected from project sampling tasks and used in project reports will be appropriately identified and will be included in a separate appendix within the RI report. Data will be reported in units in accordance with industry standards. Where test data has been reduced, the method of reduction will be described in the report.

Data will consist of raw output such as chromatograms, computer assisted integrations of the chromatograms, extraction, routing and quantitation sheets as well as quality control summaries. The raw data will be processed and compiled into a finished data summary. The finished data will then be submitted to the O'Brien & Gere Project Manager who will arrange for transfer of information to the USEPA and IEPA. All raw data, strip charts, and control charts will be made available to the IEPA upon specific request. It should be noted that data are to be reported in the same sequence that actual samples and QC samples are analyzed.

QUALITY CONTROL PROCEDURES

Quality control of data will involve the collection of field sample duplicates and blanks in accordance with the applicable EPA Technical Monograph listed in the Sampling Procedures section of this plan. In addition, the same standard quality control procedures established for the CLP will be employed to provide consistent, accurate, and dependable test results.

The major elements of the QA/QC program are: instrumental tuning and calibration criteria; defined analytical protocols; reagent blanks; matrix spikes; and duplicate spikes. A reagent blank will be included in each batch of up to twenty samples analyzed. Matrix spikes will also be included in each batch of up to twenty samples analyzed. A field blank consisting of diatomaceous earth for soil, or distilled water for

water will also be included as quality control samples. Duplicate analyses will be performed on 10% of both off-site soil and groundwater samples. Specific QC procedures to be employed are presented in Tables C-1 and C-2.

The results of duplicate (or replicate) analyses provide information on the overall precision of the analytical methodology. Quantitative results are obtained by calculating the relative percent difference (RPD) for each analyte in the sample matrix.

Duplicate samples are used to provide assurance that the procedure is under control and to determine the statistical limit of uncertainty (i.e., precision). Synthetic standards and spiked samples are used to determine the quantification of the laboratory accuracy.

AUDIT PROCEDURES

The O'Brien & Gere Project Manager, the NL Project Manager and the Program Managers will monitor and audit the performance of the QA procedures listed in this plan. They will conduct field and office audits.

QA/QC AUDITS AND FREQUENCY

The Quality Assurance program is audited weekly for overall adherence to the guidelines and procedures outlined. The QA/QC group leader is responsible for scheduling and ensuring that each audit occurs.

Monthly meetings are scheduled between the QA/QC group leader and manager of Analytical Services to thoroughly discuss the program. Any corrective action required is monitored and ensured by the QA/QC group leader.

Performance audit samples will be sent by the USEPA as deemed appropriate.

PREVENTIVE MAINTENANCE

Preventive maintenance procedures will be carried out on all field equipment in accordance with the procedures outlined by the manufacturer's equipment calibration, operation and maintenance manuals. Any field equipment used during this project that is not covered by the investigator's standard operating procedures will have a specific maintenance instruction sheet prepared for it.

DATA ASSESSMENT PROCEDURES

Analytical data will be submitted to and assessed by the O'Brien & Gere Project Manager and the IEPA and USEPA in accordance with their standard procedures. Analytical data will be assessed based on laboratory performance for meeting instrument tuning criteria, spike recovery, duplicate analysis and reagent and field blank integrity.

CORRECTIVE ACTION PROCEDURES

Corrective action procedures that might be implemented from audit results or upon detection of data unacceptability are developed on a case-by-case basis. Such actions may include altering procedures in the field, using a different batch of containers, or recommending an audit of laboratory procedures. The O'Brien & Gere Project Team Manager is responsible for initiating the corrective action. The Project Director is responsible for approving the corrective action.

QUALITY ASSURANCE REPORTS

For this project, no separate report is anticipated to describe the performance of the data measurement systems or the data quality. Instead, the final RI report and the final FS report will contain separate QA sections that summarize data quality information collected during the project.

TABLE C-1

QA/QC OBJECTIVES FOR FILTERED AQUEOUS SAMPLES
AND UNFILTERED GROUND WATER SAMPLES FOR LEAD

Parameter	Method[1]		Detection Limit (ppb)	Average Accuracy	Precision	Completeness
Antimony	204.2	Furnace*	20	85-115%	20%	100%
Arsenic	206.2	Furnace	5	85-115%	20%	100%
Cadmium	213.2	Furnace*	1	85-115%	10%	100%
Chromium	218.2	Furnace*	5	85-115%	10%	100%
Copper	220.2	Furnace*	10	85-115%	10%	100%
Iron	236.1	Flame	100	85-115%	10%	100%
Lead**	239.2	Furnace*	5	85-115%	10%	100%
Mercury	245.1	Cold Vapor	0.2	85-115%	20%	100%
Manganese	243.1	Flame	25	85-115%	10%	100%
Nickel	249.2	Furnace*	10	85-115%	10%	100%
Selenium	270.2	Furnace	2	85-115%	20%	100%
Silver	272.2	Furnace*	5	85-115%	10%	100%
Zinc	289.1	Flame	20	85-115%	10%	100%
Barium	208.1	Flame	1,000	85-115%	10%	100%
Sulfate	375.3	Gravimetric	10,000	85-115%	20%	100%
TDS	160.1	Gravimetric	10,000	85-115%	20%	100%

Quality Control Measures

- Analyze one Field Blank - no positives.
- Analyze one Method Blank - no positives.
- Analyze one matrix spike for every 10 samples - acceptable recoveries 75-125%.
- Analyze one duplicate for every 20 samples.

- Furnace methods
  - Lanthanum nitrate added for sulfate suppression in analysis of lead.
  - All solutions will be quantified by method of standard additions as appropriate, consistent with pages Metals-1, -8, -9, and -12 of reference 1.

- Flame methods
  - Potassium chloride added for barium analysis - nitrous oxide flame.

*Either the appropriate flame or furnace method is acceptable. However, if the flame method is utilized and concentrations are less than 3 to 5 times the detection limit, the results will be verified by the furnace method.

**All unfiltered ground water samples will be digested using Method 3020. Any spikes will be matrix spikes prior to digestion. All final solutions will be quantified by method of standard additions as appropriate, consistent with pages Metals-1, -8, -9, and -12 of reference 1.

[1] USEPA, "Methods for Chemical Analyses of Water and Wastes," March, 1979.

TABLE C-2

QA/QC OBJECTIVES FOR SOIL, SEDIMENT, SOLID AND UNFILTERED AQUEOUS SAMPLES

Parameter	Method[1]		Digestion[2]	Detection Limit in Final Digestate (ug/l)	Average Accuracy	Precision	Completeness
Antimony	204.2	Furnace	3050	20	75-125%	25%	90%
Arsenic	206.2	Furnace	3050	5	75-125%	25%	90%
Barium	208.1	Flame	3050	200	75-125%	25%	90%
Cadmium	213.1	Flame	3050	20	75-125%	25%	90%
Chromium	218.1	Flame	3050	50	75-125%	25%	90%
Copper	220.1	Flame	3050	50	75-125%	25%	90%
Iron	236.1	Flame	3050	50	75-125%	25%	90%
Lead	239.1	Flame*	3050	200	75-125%	25%	90%
Manganese	243.1	Flame	3050	25	75-125%	25%	90%
Mercury	245.1	Cold Vapor	7471	0.2	75-125%	25%	90%
Nickel	249.1	Flame	3050	100	75-125%	25%	90%
Selenium	270.2	Furnace	3050	20	75-125%	25%	90%
Silver	272.1	Flame	3050	50	75-125%	25%	90%
Zinc	289.1	Flame	3050	50	75-125%	25%	90%

Quality Control Measures

- Analyze two solid reference materials from EMSL - Cincinnati, and/or the National Bureau of Standards.
- Spike standard solution into distilled water and proceed through Digestion Method 3050.
- Spike two digestates with all metals of interest and analyze for recoveries - acceptable recoveries 65-135%.
- Analyze one Field blank - no positives.
- Analyze one Method blank - no positives.
- If recoveries are outside acceptable limit, method of standard additions will be used for furnace methods.

* Digested by Method 3010 for surface runoff lead analysis.

[1] USEPA, "Methods for Chemical Analyses of Water and Wastes," March, 1979.

[2] USEPA, "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods," SW-846, 1984.

TABLE C-2

QA/QC OBJECTIVES FOR SOIL, SEDIMENT, SOLID AND UNFILTERED AQUEOUS SAMPLES
(Continued)

- Digestion
  - Samples will be subjected to Method 3050 for digestion.
  - Hydrochloric acid final reflux for analysis of Sb, Ag, Cd, Cr, Cu, Pb, Ni, Zn.
  - Nitric acid final reflux for analysis of As, Se, Fe, Mn, Ba.
- Analysis
  - Barium - Potassium chloride addition - nitrous oxide flame.
  - Chromium - nitrous oxide flame.
  - If silver results are greater than 1 ppm will require analysis of nitric acid reflux solution.
  - Lead in soil analysis will spike at 10-30 mg/l in final digestate as a matrix spike prior to sample digestion.

ATTACHMENT C-1

PRIMARY CONTACTS

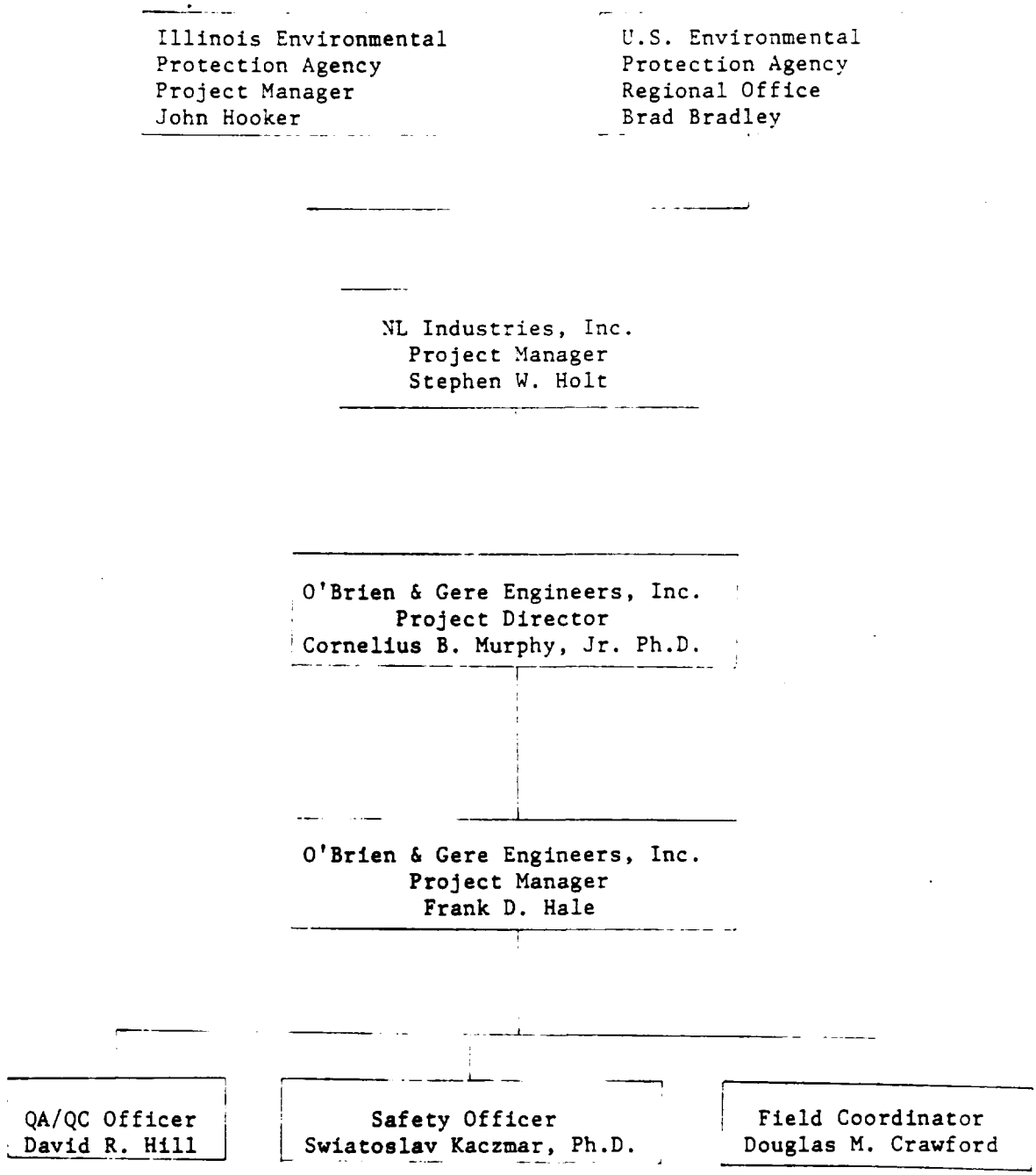
PRIMARY CONTACTS

Name and Responsibility	Organization and Address	Phone Number
Mr. John C. Hooker Project Manager Illinois Environmental Protection Agency	Illinois Environmental Protection Agency 2200 Churchill Road Springfield, IL 62706	(217) 782-6760
Mr. Jim Frank Illinois Environmental Protection Agency	Illinois Environmental Protection Agency 2200 Churchill Road Springfield, IL 62706	(217) 782-6760
Mr. Brad Bradley Region V U.S. Environmental Protection Agency	U.S. Environmental Protection Agency 230 South Dearborn St. Chicago, IL 60604	(312) 886-4742
Mr. Russell E. Diefenbach Region V U.S. Environmental Protection Agency	U.S. Environmental Protection Agency 230 South Dearborn St. Chicago, IL 60604	(312) 886-4726
Mr. Stephen W. Holt Environmental Control Dept. NL Industries, Inc.	NL Industries, Inc. P.O. Box 1090 Hightstown, NJ 08520	(609) 443-2405
Dr. Cornelius B. Murphy, Jr. Senior Vice President O'Brien & Gere Engineers, Inc.	O'Brien & Gere Engineers, Inc. 1304 Buckley Road Syracuse, NY 13221	(315) 451-4700
Mr. Frank D. Hale Research Manager O'Brien & Gere Engineers, Inc.	O'Brien & Gere Engineers, Inc. 1304 Buckley Road Syracuse, NY 13221	(315) 451-4700

ATTACHMENT C-2

PROJECT ORGANIZATION

PROJECT ORGANIZATION
Remedial Investigation/Feasibility Study
NL-Industries - Granite City Site



ATTACHMENT C-3

LABORATORY QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

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Introduction

O'Brien & Gere has been involved in the analysis of environmental contaminants for a wide range of federal, state, municipal and industrial clients. For several years, the laboratory has analyzed over 10,000 samples for over 100,000 parameters on an annual basis.

In this document concepts are presented to outline the laboratory program purpose, policies, organization and operations established to support physico-chemical analyses conducted under USEPA compliance. Implementation of this program will better insure the validity of the data acquisition, and, therefore, will provide a more reliable foundation on which to base decisions. The principles and procedures used are the result of considerations of the general operations and trends in the field of analytical chemistry, analytical instrumentation, statistical quality control techniques, and previous experiences in the laboratory programs conducted under USEPA, local and state government compliance.

General Facilities

The laboratory is located in the corporate headquarters of O'Brien & Gere in Syracuse. The laboratory maintains a staff of sixteen chemists, biologists and technicians. As many as ten temporary and part-time personnel have been used to meet peak demands. The staff maintains a constant awareness of state-of-the art techniques in environmental analysis through its review of literature. The laboratory has 3700 square feet to utilize for the preparation and analysis of samples and 1200 square feet for receiving and storage of reagents. The physical layout of the laboratory is illustrated in Figure C-3-1.

The laboratory's involvement in a variety of programs has provided the necessary experience in microbiological, inorganic contaminants and trace organic identification and quantification. Particular expertise has been developed in the area of hazardous waste identification and trace organics analysis including priority pollutants and PCB's. A brief description of available instrumentation, computer services, sample storage and receiving follows.

Laboratory Instrumentation

The following analytical instrumentation is located in the Syracuse office and has been used on a number of major analytical programs:

(a) Hewlett Packard 5993B - Gas Chromatograph/Mass Spectrometer Data System - for the low level identification of organic priority pollutants and other compounds. The unit is equipped with a dual disc, 32K computer and 9-track magnetic tape.

(b) Hewlett Packard 5880A - Gas Chromatograph equipped with dual electron capture detectors. The fully automated system has capabilities for both packed and capillary column work. The system can operate unattended around the clock to provide rapid turnaround of results.

(c) Tracor Model MT220 gas chromatograph equipped with electron capture and dual flame ionization. The unit is interfaced to a Hewlett Packard Model 3380 S integrator.

(d) Two Tracor Model 550 gas chromatographs, both equipped with Hall electrolytic conductivity detectors, linearized electron capture detectors, and photoionization detectors interfaced to Hewlett Packard Model 3390 integrators.

(e) Due to the highly specialized procedures for cleaning glassware used in the low level analysis of halogenated organics and other substances, a sonic cleaner is utilized. Additionally, a complete glassware supply including Soxhlet extractors, separatory funnels, flasks and chromatographic columns is maintained.

(f) Two Technicon Auto Analyzers, single and dual channel, for the automated determination of nutrients and other inorganic parameters.

(g) Perkin-Elmer Model 290B Atomic Absorption Spectrophotometer for the determination of metals by flame techniques.

(h) Perkin-Elmer Model 3030B Atomic Absorption Spectrophotometer for the detection of metals by furnace techniques.

(i) Varian Model 575 Atomic Absorption Spectrophotometer for the low-level detection of metals by conventional flame and graphite furnace (flameless) techniques.

(j) Beckman Model 915 Total Organic Carbon Analyzer, for the determination of organic, inorganic or total carbon.

(k) Dohrman Model DX-20 Total Organic Halide Analyzer, and Model MCTS 20/30 Elemental Analyzer for the determination of chlorine and sulfur in environmental samples.

(l) Bausch & Lomb Model 340 colorimeter, used for those colorimetric procedures not performed on the Auto Analyzers.

(m) DuPont Model 760 Luminescence Biometer for the determination of adenosine triphosphate (ATP).

(n) Orion Model 4 Specific Ion Meter.

(o) Mettler Model HE10 Electronic Semi-Micro Balance.

(p) Hiack Particle Counter for the determination of particle sizes in water ranging from 0.5 microns to 300 microns.

(q) A walk-in refrigerator for storage of samples prior to analysis. The laboratory also maintains a wide range of the usual supporting equipment such as pH meters, analytical balances, ovens and incubators, refrigerators and hood space.

Computer Services

The hardware which serves as the foundation of the firm's computer facilities has been responsible for the ability of the O'Brien & Gere laboratory to store and retrieve all data for individual clients.

The quantity of data has led to the development and utilization of a computer-based data management system. Samples are logged in, analyses are scheduled and output is received, all via time-shared or batch computer programs. One of the benefits of this system is that turnaround time has been reduced to a practical minimum. Data can be reported in a variety of formats. The standard computer output includes sample identification and various test results. A variety of statistical and modeling programs are available for the evaluation and interpretation of data.

Laboratory Policy

The management of O'Brien & Gere's Laboratory is firmly committed to the Quality Assurance/Quality Control (QA/AC) program depicted in this manual. The program has been implemented and is maintained to assure any data reported by the laboratory are of known and documented quality commensurate with their intended use. The technical personnel who contribute to all or any portion of the laboratory analyses follow the procedures delineated in this manual.

The QA/QC manual is an integral part of a generalized representation of our Good Laboratory Practice program. It is primarily intended to set control guidelines and direction for all the physico-chemical and microbiological measurements performed by the laboratory. The contents of this manual will be re-evaluated yearly by the QA/QC group leader, and if necessary, revisions will be made, and/or the QA/QC program expanded.

A supplementary laboratory manual dealing with specific technical areas has been written and is available to all laboratory personnel. The laboratory manual is reviewed and approved by the QA/QC, Trace Organics and Wet Chemistry group leaders and management prior to distribution to the laboratory staff.

Quality Control Program Objectives

The primary objective of the O'Brien & Gere Laboratory QA/QC program is to assure the precision and accuracy of all data generated by the laboratory personnel. That is, the data is of known and documented quality.

The QA/QC guidelines are implemented in support of the laboratory surveillance programs and analyses efforts. They reflect the best cost effective effort, and are used to assess, ensure and document that all data collected, stored, reported or used by the laboratory are scientifically valid, defensible and of known precision and accuracy.

The major effort of the QA/QC program will be to develop a workable day-to-day "QA/QC model", and thus provide the detailed control charts and control limits to measure the laboratory daily performance. The QA/QC activities shall be carried out in accordance with EPA, state and local government mandates. The implementation, coordination and supervision of these procedures will provide the customer with the quality assurance (QA) activities associated with good laboratory practices.

Personnel and Organization

Any organization consists of a number of people whose skills and delegated responsibilities assure the quality of the ultimate product, i.e. analytical services. QA/QC procedures commence when the sample is first collected, and continues until the final product is in the client's hand. An organizational chart of the laboratory technical staff is included in Figure C-3-2 to serve as a frame of reference for all QA/QC procedures.

The Laboratory Manager is responsible for the overall administration of the analytical operations at O'Brien & Gere. The section group leaders handle the day to day scheduling and operation, and report to the manager. Together with the group leaders they review and approve all policies concerning their specific areas of responsibility.

The QA/QC group leader is responsible for the implementation, monitoring and supervision of the QA/QC program. He assures that the program is conducted in strict adherence to procedures and requirements outlined in this manual. He reports to the Laboratory Manager, and interacts daily with other group leaders and laboratory staff. His duties include:

1. Develops and implements new QA/QC programs, including statistical techniques and procedures.

2. Conducts regular inspections and audits of analytical procedures.

3. Daily monitors accuracy and precision and implements correction measures if "out of control".

4. Maintains copies of all procedures routinely used in the laboratory measurements.

5. Informs management of the status of the QA/QC program by annual status reports.

6. Coordinates and conducts investigations of any customer complaints regarding quality.

7. Reschedule any analysis based on poor accuracy or precision data.

The section group leaders are responsible for the day to day operation and technical questions concerning analytical protocol and together with the QA/QC group leader:

1. Maintain and increase the technical skills of the laboratory technical personnel to achieve optimum quality results.

2. Approve analytical methods, sampling procedures, special QA/QC procedures, and any subsequent revisions in analytical procedures used in their respective areas.

3. Approve completed work.

The resumes of the O'Brien & Gere Laboratory's Manager, QA/QC Group Leader, Wet Chemistry Group Leader, and Trace Organics Group Leader are presented in Attachment C-3-4.

Technical Training

All personnel involved in any function affecting data quality (sample collection, analysis, data reduction, and quality assurance) have sufficient technical training (in their appointed positions) to contribute to the reporting of complete and high quality data. The training is achieved through: a) On-the-job training, b) Short-term courses (one week or less), and c) Long-term courses (one semester or longer).

Short and long term courses are available through universities, colleges, and technical schools in statistics, analytical chemistry, and other disciplines. In addition, short-term courses are provided by commercial training organizations, manufacturers of equipment and others.

The trainee and/or analyst performance is evaluated by providing unknown samples for analysis. An unknown, as defined here, is a sample whose concentration is known to the QA/QC group leader or other group leaders but is unknown to the trainee or analyst. Proficiency is judged in terms of accuracy.

Certification

The U.S. Environmental Protection Agency certifies state laboratories to conduct their own intrastate program of certification for the proficiency of private laboratories in potable water analysis. The EPA only certifies private laboratories directly in those states which have not been approved to establish their own programs. In New York State, the certifying agency is the NYS Department of Health. The Firm's laboratory was one of the first participants in the New York State program and has been certified for chemical atomic absorption, bacteriological

and gas chromatographic analysis of water since 1974. Laboratory certification has been extended to the states of Massachusetts, Pennsylvania and New Jersey.

Additionally, the laboratory participates in the round robin analyses of reference samples supplied by the EPA and in the analysis of commercially available reference samples. The laboratory has provided analytical services in projects supported by EPA.

SECTION 2 - GENERAL CONSIDERATIONS

Maintenance

A preventative maintenance schedule on all instruments, balances, and equipment requiring maintenance is followed. All maintenance, whether performed by the laboratory or other professional sources, is documented in appropriate log books. Entries are made each time maintenance is performed and include the reason for maintenance, what was performed, by whom, and the dates and initials of the analyst in charge during the maintenance.

Calibration

Thermometers needed for critical temperature determination and control are calibrated against an NBS thermometer on site once a year. Analytical balances are professionally calibrated and cleaned once a year and checked with Class S weights daily by analysts who routinely use the balances. Calibration data are entered into a specific calibration notebook, which is kept with the equipment being calibrated. When the balances are professionally calibrated, a document stating the specific balance (model and serial number), its location, and the data calibrated is provided by the company or individual providing such service.

Reagent Quality

The quality of reagents and instrument readings are maintained by the following procedures:

(a) Reagents for quantitative purposes are ACS analytical quality grade or better.

(b) Each sample is collected in a new container to minimize contamination.

(c) All glassware is cleaned and rinsed with distilled water and visually inspected before use. Any volumetric glassware found to be etched or cracked is discarded.

(d) The operating temperatures of all ovens, incubators, water baths and refrigerators are recorded daily in the quality control log.

(e) All reagents are discarded after a set interval which has been established and recorded in the Laboratory Handbook.

(f) The date a prepared reagent and/or standards are made is entered into the Log book and initialed by the preparer. Therefore, the results which have been affected by a contaminated or otherwise improper reagent can be easily determined. These results are either recalculated or discarded and the analysis may be repeated if possible. Reagent

containers are also dated when new solutions are prepared and are initialed. These procedures are followed for all (even daily) preparations.

Audits and Inspections

The Quality Assurance program is audited weekly for overall adherence to the guidelines and procedures outlined in this manual. This audit includes the submission of a blind known sample. The QA/QC group leader reviews the audit results and documents the performance.

Should excursion occur, based on three standard deviations, from the mean, the QA/QC group leader investigates the problem by speaking directly to the analyst. If the QA/QC sample is truly outside the control limits all samples are reanalyzed.

Monthly meetings are scheduled between the QA/QC group leader and manager of Analytical Services to thoroughly discuss the program. Any corrective action required is monitored and ensured by the QA/QC group leader.

In addition to the above activities, performance audit samples sent by the USEPA to the laboratory will be analyzed.

SECTION 3 - SAMPLE COLLECTION AND TRACKING

Valid Representative samples of environmental matrices are collected through well defined sampling protocols. The sampling may be performed by the laboratory sampling team, or the customer who then assumes responsibility for properly obtaining, handling, preserving and shipping the sample.

Sample Collection and Handling

A well defined sampling protocol must ensure that:

a. sampling team members are competent and qualified
b. proper sampling methods are used
c. equipment is accurately calibrated
d. all samples are properly handled to prevent contamination
e. samples analyzed are actually the samples collected under reported conditions.

Samples are kept in secure places from time of collection until they are analyzed. It is the joint responsibility of the group leader and sampling team leader to ensure that approved methods are used, and it is the responsibility of each sampling technician to assure that the equipment is accurately calibrated.

Field custody procedures will be conducted in accordance with the procedures outlined in NEIC Policies and Procedures (EPA-330/9-78-001-R, Revised June 1985).

Chain of Custody

The laboratory sampling protocol follows a chain of custody procedure. The procedure creates an accurate, written, legally defensible document that can be used to trace possession of sample from its collection through analysis and final disposal.

The basic elements in the chain-of-custody phase of our QA/QC program are:

1. Sample collection and handling
2. Sample analysis
3. Preparation and filing of test report

These measures are documented by the chain of custody form (Figure C-3-3) signed by all handlers of the sample(s). As defined here, a sample is "in custody" if it is:

a. in actual physical possession, or
b. in view after being in physical possession, or
c. in a locked repository, or
d. in a secure, restricted area.

Laboratory custody procedures will be conducted in accordance with NEIC Policies and Procedures (EPA-330/9-78-001-R, Revised June 1985).

Analysis, Preparation and Filing of Test Report

A critical concern of the QA/QC program is the maintenance of sample and data base integrity and the timely preparation of data reports. The data management program allows for the identification of samples and the maintenance of the discrete character of the data generated by each respective sample. This system is a unique advantage over manual methods and has permitted the laboratory to successfully tabulate data involving high numbers of samples and multiple analyses. The system may be divided into the following phases:

1. sample identification -- as each sample enters the laboratory, it is assigned a unique access number found on a sample identification ticket. This identifier permits the discrete organization of all information and data relating to that sample, whether for analytical identification purposes, reference in paper-copy records and correspondence, or computer storage and recall.

2. data organization -- in a preliminary planning phase of any analytical investigation involving the laboratory, a computer codification format can be established which can serve as the basis for storage and retrieval of data. This format is characterized by the categorization of samples, with any type of identification permissible for the classification. The categories may be based on any similarities (or dissimilarities) in the total volume of samples.

   The storage and retrieval of quality control sample data is also managed with the laboratory's computer-based data management system. Samples are tagged and data is input, stored and retrieved as with any routine project samples. This has been made possible by the use of a unique quality control project number by which such data may be identified.

Final Evidence Files

Upon completion of the project objectives, all relevant project documents will be arranged in a final evidence file. The final evidence file will be developed pursuant to guidance provided in NEIC Policies and Procedures (EPA-330/9-78-001-R, Revised June 1985), and will include the following document categories:

A. Project Plan(s)
B. Project logbooks
C. Field documentation, including notebooks

D. Sample identification documents
E. Chain-of-Custody Records
F. Analytical logbooks, lab data, calculations, bench cards, graphs, etc.
G. Correspondence
H. Report notes, calculations, etc.
I. References, literature
J. Sample inventory
K. Check-out logs
L. Litigation documents
M. Miscellaneous-photos, maps, drawings, etc.
N. Final Repoort

SECTION 4 - INTRALABORATORY QA/QC PROGRAM

A quality control program is a systematic attempt to assure the precision and accuracy of analyses by detecting and preventing recurrency of errors, or measuring the degree of error inherent in the proven methods used. By identifying the sources of errors confidence in the precision and accuracy of analytical results can be established and improvements in the analytical methods made. To ensure the precision and accuracy of a result our quality control program requires the measurement and analysis of spiked samples, duplicate samples, synthetic standards and blanks.

Duplicate samples are used to provide assurance that the procedure is under control and to determine the statistical limit of uncertainty (i.e., precisions). Synthetic standards and spiked samples are used to determine the quantification of the laboratory accuracy.

In general, our quality control program incorporates the concepts of: a) calibration to attain accuracy, b) replication to establish precision limits, and c) correlation of quantitatively related tests (synthetic standards and spikes) to confirm accuracy.

The overall effectiveness of the program is dependent upon the evaluation of: a) equipment and instruments, b) current state of the art, c) precision of the analytical method itself, d) expected ranges of analytical results, e) control charts to determine trends as well as gross errors, f) data sheets and laboratory procedures adopted for control of sample integrity, g) quality control results on a daily as well as on varying time frames.

Definitions of Basic Terms

Before we discuss the standard operating practice for the QA/QC program some definitions are in order. These are:

1. Reagent Blank - The reagent (or method) blank is an aliquot of pure, organic free water (or organic reagents) used in the analysis of samples. It is generated by passing the clean matrices through the entire analytical procedure (including all glassware and other materials that come into contact with the sample). These blanks are analyzed along with the samples to verify that: a) qualitatively, no false positives occur, and b) quantitatively, concentrations are accurate and do not reflect contamination.

2. Duplicates - Duplicates are the result of splitting a field sample into equal amounts and are treated throughout as two unique samples. The results of duplicate (or replicate) analyses provide information on the overall precision of the analytical methodology. Quantitative results are obtained by calculating the relative percent difference (RPD) for each analyte in the sample matrix.

3. Spike - Spikes are the result of the addition of a known amount of analyte to a sample or a blank. The analytical results yield a quantitative measure of accuracy (spiked blanks) or percent recovery (spiked samples). The measured accuracy reflects the best result which can be expected, whereas the percent recovery reflects matrix effects upon the analytical method accuracy.

   Two spiking levels are necessary when analyzing different samples. Relatively clean samples are spiked at detection limit and 10 times the detection limit for each component. Highly polluted samples are spiked at 100 times the detection limit for each component. Ideally, the spike should be 50 - 100% of the original concentration of each analyte in the sample matrix. If the added spike is less than 10% of the sample result, the data are questionable and statistically unacceptable.

4. Reference Standard (reference audits) - These are the analysis of independently prepared standard solutions or synthetic standards. Two types of standards are used, i.e., a) internal reference standard solutions (synthetic standards prepared in-house), and b) external reference standard solutions obtained from outside sources (i.e., primarily EPA).

   The external audits samples are used for monitoring the complete analytical method. These samples are introduced at the onset of the procedure (typically digestion) and carried through the entire analysis.

   The internal standard audits are used to verify the "accuracy" of quantitative instrument calibration. All standard solutions are prepared by the QA/QC group leader and are submitted blind for analyses. The analyst analyzes the solutions as discrete samples and a percent recovery or percent error is calculated. Errors greater than 5% are carefully investigated and differences resolved through proper action.

Guidelines for Evaluating the QA/QC Program

The major pieces of analytical equipment to be used in this project are a Varian Model 575 Atomic Absorption Spectrophotometer and a Perkin-Elmer Model 3030B Atomic Absorption Spectrophotometer for the low-level detection of metals by conventional flame and graphite furnace (flameless) techniques. This section defines the QA/QC program for the analysis of inorganic pollutants by atomic absorption (AA) spectrophotometry.

Atomic Absorption Spectrophotometry

The atomic absorption spectrophotometer is calibrated using appropriate calibrating standards and blanks. The calibrations are checked by analyzing synthetic standards at five different concentration levels.

The results are used to generate standard curves by least squares fit of the data via computer programs. The deviation of the standards from the least squares fit (standard curves) and the standard deviation of the fit are printed on the daily printout and the data stored accordingly in appropriate computer basis. If deviation from accepted values occur, analysis of sample and instrumental calibrations are repeated. Standard curves are generated regularly.

Spectrophotometric instruments are checked by comparing the gain settings or percent transmittance for known (synthetic) standards to previous values. This monitoring method shows any decrease in sensitivity or other systematic effects in performance.

Routine Analysis

The quality of the analytical data generated during routine analyses is monitored by the following:

1. Contamination from reagents and glassware is identified by analyzing a reagent blank. One reagent blank is prepared for every 20 or fewer samples analyzed (or when a new lot of reagent is used in the analysis).

2. The analytical method accuracy is determined by spiking a known amount of analyte into a sample and blank. The percent recoveries are then calculated. The amount of analyte recovered from the blank indicates the best result which can be expected from the method. The amount of analyte recovered from a sample reflects matrix effects upon the accuracy of the method. Two spikes are prepared for every 20 or fewer samples analyzed.

3. The analytical method precision is determined by analyzing equal amounts of a split sample. Ideally, the analytical results will be identical; however, differences occur due to variations in the procedure. A quantitative measure of these differences is assessed by calculating the relative percent differences (RPD) for each analyte in the matrix and the results compared.

   In general, one duplicate is analyzed for every 20 or fewer samples, and the performance of the analytical instrument verified. Whenever possible, identification is confirmed by a second procedure.

SECTION 5 - METHODS AND PROCEDURES

The laboratory will analyze a variety of samples for heavy metals, sulfate, and total dissolved solids to determine the extent of metal contamination. Samples will be collected from the slag pile, St. Louis Lead Recycler's pile, drums, and ground water and analyzed for a variety of metals. Soil and surface water samples will be collected and analyzed for lead. The purpose of the analytical procedures is to identify the concentrations of heavy metals. The procedures referenced will represent order of magnitude differences as compared to absolute concentrations. The intent is to identify the problem areas for remedial alternatives.

The extraction procedure (EP) will be conducted on the off-site soil sample having the highest total lead concentration above 1000 ppm. The EP Toxicity test method is Method 1310 found in reference 1.

Specific information regarding analytical procedures, the instrument detection limits, range of calibration curves, sample preparation, pretreatment procedures, and interferences for each of the methods may be found in the referenced text and Tables C-1 and C-2 of the QAPP.

References

1) "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (SW 846)" USEPA, 1984.

2) "Methods for Chemical Analyses of Water and Wastes," USEPA, March, 1979.

SECTION 6 - DEFINITIONS OF STATISTICAL TERMS

The following statistical term definitions are used to identify statistical reports and evaluations:

a. Accuracy and Precision - Accuracy is a measure of the nearness of an analytical result, or a set of results, to the true value. It is usually expressed in terms of error, bias, or percent recovery (PR).

Normally the term "accuracy" is used synonymously with "percent recovery". It describes either the recovery of a synthetic standard of known value, or the recovery of known amount of analyte (spike) added to a sample of known value. The percent recovery (PR) or "accuracy" can be calculated by using:

1. standards: PR = (observed value/true value) x 100

2. spikes: $$PR = \frac{\text{(conc. spike + sample) - sample}}{\text{conc. spike}} \times 100$$

Precision refers to the agreement or reproducibility of a set of replicate results among themselves without assumption of any prior information as to the true result. It is usually expressed in terms of the deviation, variance, or range. Good precision often is an indication of good accuracy, however, one can obtain good precision with poor accuracy if systematic (determinate) errors are present in the method or instrument used. Systematic errors are either positive or negative in sign. Other analytical errors are indeterminate (random) errors. These are inherent in the analytical methods due to uncertainties in measurements.

b. Average - The average or arithmetic mean ($\bar{X}$) of a set of n values (Xi) is calculated by summing the individual values and dividing by n:

$$\bar{X} = \left[\sum_{i=1}^{n} X_i\right] / n$$

c. Range - The range (R_i) is the difference between the highest and lowest value in a group. For n sets of duplicate values (X_2, X_1) the range (R_i) of the duplicates and the average range ($\bar{R}$) of the n sets are calculated by:

$$R_i = \left| X_2 - X_1 \right|$$

and

$$\bar{R} = \left[\sum_{i=1}^{n} R_i\right]/n$$

d. Standard Deviation and Variation - The standard deviation (S) of a sample of n results is the most widely used measure to described the dispersion of a data set. It is calculated by using the equation

$$S = \sqrt{\frac{\sum_{i=i}^{n}(X_i - \bar{X})^2}{n-1}}$$

where $\bar{X}$ is the average of the n results and X_i is the value of result i. Normally, $\bar{X} \pm S$ will include 68% and $\bar{X} \pm 2S$ about 95% of the data in a normal distribution curve.

The variance is equal to S^2. The relative standard deviation (RSD) or coefficient of variation (CV) is the standard deviation divided by the mean and multiplied by 100, i.e.,

$$CV = 100S/\bar{X}$$

It is interesting to note that the precision is increased (value of S reduced) by increasing the number of duplicate analysis. The greater the number of replicate analysis, the greater the statistical confidence that the true mean lies within certain limits about the experimental mean.

e. Standard Calibration Curves - standard calibration curves are widely used in the analysis of inorganic pollutants. These curves are generated from the results of analyses of three or more standard solutions of known concentration and a blank. Typically, they are plots of the instrument response versus concentration. A plot is defined as linear, i.e., obeys the linear equation Y=a + bX, if the correlation coefficient (R) calculated from the linear regression analysis is 0.996 or greater.

The intercept (a), slope (b) and correlation coefficients (R_c) can be calculated from:

$$a = \frac{\Sigma X^2 \Sigma Y^2 - \Sigma X \Sigma Y}{n\Sigma X^2 - (\Sigma X)^2}$$

$$b = \frac{n\Sigma XY - \Sigma X \Sigma Y}{n\Sigma X^2 - (\Sigma X)^2}$$

$$R_c = \frac{\Sigma(X_i - \bar{X})^2 (Y_i - \bar{Y})^2}{\sqrt{\Sigma(X_i - \bar{X})^2 \Sigma(Y_i - \bar{Y})^2}}$$

We fit the analytical data to a linear regression analysis by using a computer program.

f. Absolute and Relative Errors - An absolute error is the difference between the experimental result and the true value. The relative error is the absolute error divided by the true value and multiplied by 100 to yield the percent relative error (PRE). When the true value is not known, the PRE is a measure of the difference (range) of a replicate analysis divided by the mean of the replicate value and multiplying by 100. That is, for duplicates

$$PRE = \frac{100\,|X_2 - X_1|}{(X_2 + X_1)/2} = \frac{100\,|X_2 - X_1|}{\bar{X}_i}$$

g. Skewness and Kurtosis - Skewness and kurtosis are the numbers used to understand the shape of a given curve. Our groups are data bases of spikes, duplicates, and knowns. The data points in these groups should fall within a normal curve. Aberrations from the normal curve are detected in values of skewness and kurtosis.

Skewness defines the symmetry of a curve. A symmetrical curve must have a skewness of zero. Positive or negative values denote lack of symmetry. Kurtosis defines the peakedness of a curve. A normal distribution curve will have a kurtotic value of 3. Peaked curves will have values greater than three, and broad flat curves will have values less than 3. These values are monitored by the QA/QC group leader. When aberrant values are noted, the interpretation is usually related to very high or low QC values entering data bases or the persistence of patterns of consistently high or low QC values. It is the QA/QC coordinator's responsibility to research the causes of excessive values and patterns and, where possible, rectify the analytical conditions leading to them.

References

1) "Handbook for Analytical Quality Control in Water and Wastewater Laboratories," March, 1979 (EPA-600/4-79-019)

2) "Manual of Analytical Quality Control for Pesticides and Related Compounds in Human and Environmental Samples," January, 1979 (EPA-600/1-79-008)

SECTION 7 - STATISTICAL QUALITY CONTROL AND THE "DAILY QC MODEL"

Random (indeterminate) and systematic (determinate) errors are inherent in all analytical methods due to uncertainties in measurements. The measurement of physico-chemical and microbiological properties of pollutants in various environmental matrices involve uncertainties which cannot be entirely eliminated. The errors in these measurements, however, can be reduced to tolerable limits by examining and controlling the significant variables.

Additional errors, often unrecognized, are introduced by interfering chemical reactions and other undesirable physico-chemical effects. In many instances absolute values cannot be attained directly.

Although uncertainties cannot be reduced to zero, they can be minimized by using available statistical methods. Estimates of the accuracy (probable "true value") and precision (range of measurement error) can be made for the various analytical methodologies by analyzing blanks, duplicates, spikes and synthetic standards. After sufficient QC data are collected various statistical methods are used to evaluate the quality of data by calculating control and warning limits. A discussion of the statistical methods used follows.

Control Charts

Control charts provide the necessary tool for detecting quality variations in the various analytical methodologies used for the quantitation of environmental pollutants. They are a continuous graphic indication of the state of an analytical procedure with respect to quality, and assist in deciding when and how to take corrective action. The QC charts are generated for each pollutant from the statistical evaluation of QC data. A minimum of 15 duplicates and spiked samples and/or synthetic standard analyses are required to generate a control chart.

The control limits (CL) on QC charts are paramount criteria for assessing the significance of variations in the analytical results. For instance, when the plotted QC indicators (i.e., percent recoveries, relative percent error, etc.) fall within these limits, the analytical methodologies used are under "control". If, however, a QC indicator value falls outside the CL's, there is an indication that some assignable cause is present which has thrown the system "out of control". Thus, control limits can be considered warning or action limits. They enable us to detect deviations in analytical procedures, and therefore, take corrective action before producing erroneous results (or results which exceed the absolute maximum tolerable limits).

Common practice set warning limits (WL) at ± 2 standard (S) deviations (95% confidence level of the normal distribution curve) and control limits (CL) at ±3S limits (99.7% confidence level of the normal distribution curve) on each side of the mean. The CL and WL are calculated from the QC data of duplicates analyses by using the equations and

statistical factors listed in Table C-3-1. These CL's and WL's include approximately the entire data set under "in control" conditions, and are equivalent to the commonly used ± 3S and ± 2S limits, respectively. The qualitative relationship between upper and lower control limits, upper and lower warning limits, and the mean is shown in Figure C-3-4.

Statistical Calculations

The statistical techniques used in generating the data for $\bar{X}$ and R QC charts involves complex mathematics. The short cut methods for calculating the $\bar{X}$ and R limits are based on the equations listed in Table C-3-1. The statistical factors A_2, D_3, D_4, etc. have been calculated by statisticians such that the CL limits involve a maximum risk of making an error only 0.1% to 0.3%. Thus, when the QC charts indicate that the analytical system is "out of control" 997 times out of 1,000 it is likely that something has actually gone wrong and corrective actions are needed. The factors are calculated to yield 3S limits. Examples of QC data and the statistical techniques used to calculate precision and accuracy QC charts follow.

Precision QC Charts ($\bar{X}$ and R Charts)

These charts are developed by using a minimum of 15 to 25 QC data results on duplicate analyses. Once these data have been collected over an extended period of time the warning and controlling limits on the QC charts are calculated by using the equations and statistical coefficients listed in Table C-3-1. The procedure used follows:

(1) For each duplicate sample analysis calculate the range (R_j = @ X_2 - X_1 @) and the average ($\bar{X}j$ = (X_2 + X_1)/2) of the concentration of the duplicate set.

(2) Calculate the relative percent range (R^1_j) defined as

$$R1_j = PRE/100 = R_j/\bar{X}_j$$

where PRE is the relative error defined in Section 6.

(3) Calculate the mean ($\bar{R}^1$) relative range by summing the $R1_j$ values and divide by the total number (n) of duplicate sets, e.g.,

$$\bar{R}' = \left[\sum_{j=1}^{n} R_j\right]/n$$

(4) Calculate the grand average O$\bar{X}$J, i.e., the average of the average of n sets of duplicate averages $\bar{X}_j$ by using:

$$\langle \bar{X} \rangle = \left[\sum_{j=1}^{n} \bar{X}_j\right]/n$$

(5) Calculate the warning and control limits for R and $\bar{X}$ (see Table C-3-1) by using:

For R:

$$UCL = D_4 \bar{R}^1 = 3.27 \bar{R}^1$$

$$LCL = D_3 \bar{R}^1 = 0$$

$$UWL = \bar{R}^1 (2D_4 + 1)/3 = 2.51 \bar{R}^1$$

For $\bar{X}$:

$$UCL = \langle\bar{X}\rangle + A_2\bar{R} = \langle\bar{X}\rangle + 1.88 \bar{R}$$

$$LCL = \langle\bar{X}\rangle - A_2\bar{R} = \langle\bar{X}\rangle - 1.88 \bar{R}$$

$$UWL = \langle\bar{X}\rangle + (2/3) A_2\bar{R} = \langle\bar{X}\rangle + 1.25 \bar{R}$$

$$LWL = \langle\bar{X}\rangle - (2/3) A_2\bar{R} = \langle\bar{X}\rangle - 1.25 \bar{R}$$

Where for duplicates $D_3 = 0$, $D_4 = 3.27$, and $A_2 = 1.88$ (Table C-3-1); UCL and LCL are the upper and lower control limits, respectively; and UWL and LWL are the upper and lower warning limits. The WL's and CL's correspond, respectively, to the 95% (2S) and 99.7% (3S) confidence limits of a normal distribution curve.

(6) Graph the $\bar{R}1$, UCL, LCL and UWL on the QC charts with appropriate scales which allow additions of new results (Figure C-3-2) and the individual ($R1_j$) QC data results.

(7) Graph the $O\bar{X}J$, UCL, LCL, UWL, and LWL on the QC charts with appropriate scales which allow additions of new results and individual ($\bar{X}_j$) QC data.

(8) If QC values are "out of control", i.e., lie outside the control limits, take appropriate corrective action.

Accuracy QC Charts (P Charts)

The P charts are the same as the $\bar{X}$ and R charts since their function is to enable us to detect changes in the laboratory daily performance of analyses and take corrective action. The P QC charts utilize the sigma (i.e., standard deviation, S) as a quantitative measure of the degree of variations in the analytical methodologies.

The accuracy of the laboratory analytical methodologies is monitored via the analysis of various spiked samples and/or audits of synthetic standards. Spiked samples are also analyzed a vis field samples and the percent recovery calculated. Once a minimum of 15 QC recovery data have been collected over a period of time the warning and controlling limits are calculated and P charts developed. The procedure used follows:

(1) For each spiked sample analyzed calculate the percent recovery (PR) using the equations given in Section 6.

(2) Calculate the mean percent recovery ($\bar{PR}$) by summing the total number of PR's and divide by n (see Section 6).

(3) Calculate the standard deviation (S) from the percent recoveries (see Section 6).

(4) Calculate the warning (WL) and control (CL) limits by using:

$$CL = \text{mean} \pm 3S$$
$$WL = \text{mean} \pm 2S$$

where CL and WL denote, respectively, the upper and lower control limits, and the upper and lower warning limits; S the standard deviation; and mean the average percent recovery ($\bar{PR}$) for n spiked samples or synthetic standards. The WL and CL on the accuracy charts (similar to the precision charts) correspond, respectively, to the 95% and 99.7% confidence limits of a normal distribution curve.

(5) Graph the mean, WL, CL and the individual (PR) QC data results on the accuracy chart using appropriate scales.

(6) If QC values lie outside the control limits, the analytical method is "out of control" and appropriate corrective actions are taken.

The "Daily QC Model"

The "Daily QC Model" comprises two unique activities of our QA/QC program, i.e., the data management and monitoring specific statistical programs of data management systems on a daily basis. The salient features of the programs are discussed below.

1. Data Management

Integral to the laboratory's QA/QC program is the management of data generated from specified quality control procedures. These procedures are designed to monitor all laboratory analyses and ultimately, to ensure the highest possible quality of results. As previously mentioned, the duplicate, the spiked recovery, the synthetic known and the blank(s) are the analytical tools used to monitor the precision and accuracy of analytical methods. Recall:

(a) duplicate analyses monitor analytical method precision,

(b) spiked samples and synthetic knowns monitor analytical accuracy, and

(c) analyses of blanks account for possible sources of contamination.

The data produced from these tests is maintained via a quality control data management system which has the dual function of relating QA/QC data to analytical performance on a daily as well as varying time frames.

The key to the management of QA/QC data in the laboratory is the Firm's Honeywell X560 computer. Quality control computer programs allow for the calculations, storage, segregation, interpretation, monitoring and retrieval of each bit of QA/QC information. A discrete system of sample identification is used which allows the computer to perform these functions automatically. Each QA/QC sample is assigned a specific code identifying it as a blank, duplicate, spike or synthetic known sample. The code identifiers place each QC value in an appropriate data base which provides a permanent record of each and every quality control sample. These data base are then used as the starting point of various statistical analyses of QC data which aid in understanding the developed analytical information.

Specific statistical programs are available for the various types of QA/QC samples, and generate precision (X bar and R) and accuracy (P bar) quality control charts. These charts provide the graphic representation of the QA/QC information and are used to monitor the accuracy and precision of the various analytical methodologies daily.

2. Monitoring Statistical Programs of Data Management Systems

The QA/QC programs are made available to the QA/QC group leader and the analyst to allow daily response to analysis. The programs offer instant presentation of statistical values which are checked vis a vis the most recent mean, standard deviations and control limits calculated from each data base in the computer. As a result the QA/QC group leader and the analyst will know immediately whether or not the analytical method performance is in control (lie within acceptable ranges) and a decision can be made to accept, reject or repeat the analysis.

In addition, a program exists for the QA/QC group leader which presents all quality control information in a daily printout. On this printout, information concerning QC samples is organized for review by the QA/QC group leader. The sample number, the test parameter, the QC sample type, the date of analysis, percent recoveries, relative errors and all values necessary for the calculation of QC data are collected on this printout. In addition to the QC values, commensurate warning and control limits are given. The QA/QC group leader is able to examine these data for acceptability. A quick scan can tell him the status of unfinished samples and values of QC data entering data bases. It is at this point where errors are detected, researched, and corrected whenever possible. We feel that the use of this monitoring program minimizes elapsed time between analysis and data review, therefore, greatly improves the sensitivity of our QC program to our analyses. The earlier errors are detected and corrected, the less time is required to deliver valid results to a client.

A summary of the various QC activities and statistical calculations found in the daily printout is given in Table C-3-2. If QC values are found to lie outside the control limits, corrective actions are taken to bring the analytical method "under control". The various corrective actions are delineated in Table C-3-3.

3. Other QA/QC Functions

A further ramification of the QA/QC computer management system is the historical evaluations afforded through data storage. Data may be retrieved over long varying time frames providing solid estimates of performance limits for any given analytical parameter. By the same token knowledge of performance limits and the factors that establish them should allow for the improvement of analyses as these factors are identified and removed. Such review is used in the evaluation of new techniques, instruments, and analysts when comparisons are made to the established quality control data bases.

To assist in evaluation and historical review a statistical package is available for measuring the variability of any given data over varying time frames. The Peursonian coefficient of skewness is utilized to quantify variability of percent recoveries, duplicate ratios, and percent of unknown values.

Automatic storage of data, generation of control charts, and data examination through statistics are the tools used to manage the quality control data. The goal of the data management system is a sensitive quality control program which will allow accurate decision making processes and continuous quality of analytical results.

TABLE C-3-1 STATISTICAL FACTORS AND EQUATIONS FOR CALCULATING QC (X BAR AND R) CHART LINES[1]

Observations in Subgroup (n)	Factor			
	A_2	d_2	D_3	D_4
2	1.88	1.13	0	3.27
3	1.02	1.69	0	2.58
4	0.73	2.06	0	2.28
5	0.58	2.33	0	2.12
6	0.48	2.53	0	2.00
7	0.42	2.70	0.08	1.92
8	0.37	2.85	0.14	1.86

Upper control limit for $\bar{\bar{X}}$ = $UCL_{\bar{\bar{X}}} = O\bar{\bar{X}}J + A_2\bar{R}$

Lower control limit for $\bar{\bar{X}}$ = $LCL_{\bar{\bar{X}}} = O\bar{\bar{X}}J - A_2\bar{R}$

Upper warning limit for $\bar{\bar{X}}$ = $UWL_{\bar{\bar{X}}} = O\bar{\bar{X}}J + (2/3)\ A_2\bar{R}$

Lower warning limit for $\bar{\bar{X}}$ = $LWL_{\bar{\bar{X}}} = O\bar{\bar{X}}J - (2/3)\ A_2\bar{R}$

Upper control limit for R = $UCL_R = D_4\bar{R}$

Lower control limit for R = $LCL_R = D_3\bar{R}$

Upper Warning Limit for R = $UWL_R = \bar{R} + (2/3)(D_4\ \bar{R} - \bar{R})$

$= \bar{R}\ (2\ D_4 + 1)/3$

[1]Taken from (1) "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", March, 1979 (EPA-600/4-79-019); and (2) C. Samson, P. Hart and C. Rubin, "Fundamentals of Statistical Quality Control", Addison-Wesley (Massachusetts, 1970), p. 40.

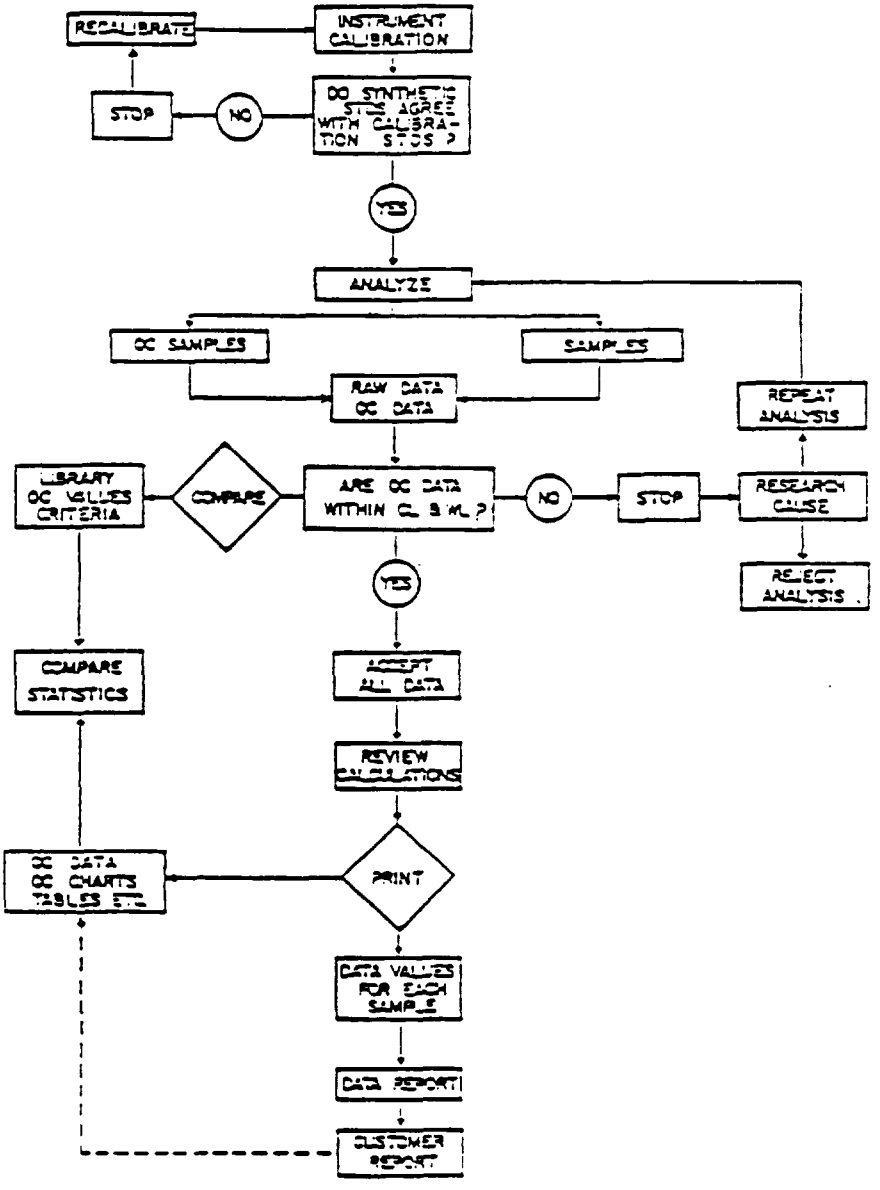
TABLE C-3-2 SUMMARY OF VARIOUS QA/QC ITEMS
ON DAILY COMPUTER PRINTOUT

ITEM	INFORMATION
CONTROL CHARTS	X Bar and R Charts (precision) P Charts (accuracy)
TABLES	Blanks Duplicates (Percent Relative Error) Spikes (Percent Recovery) Synthetic Standards (Percent Error)
WARNING PROGRAM	Outliners on all QC Data Base Mean and Standard Deviation Upper and Lower Warning and Control Limits
STATISTICS	Average, Mean and Standard Deviation Upper and Lower Warning and Control Limits Skewness and Kurtosis Percent Relative Error Percent Recovery Percent Error

TABLE C-3-3

DECISION MAKING PROCESS FOR QA/AC

PROTOCOL AND ANALYSIS OF SAMPLES



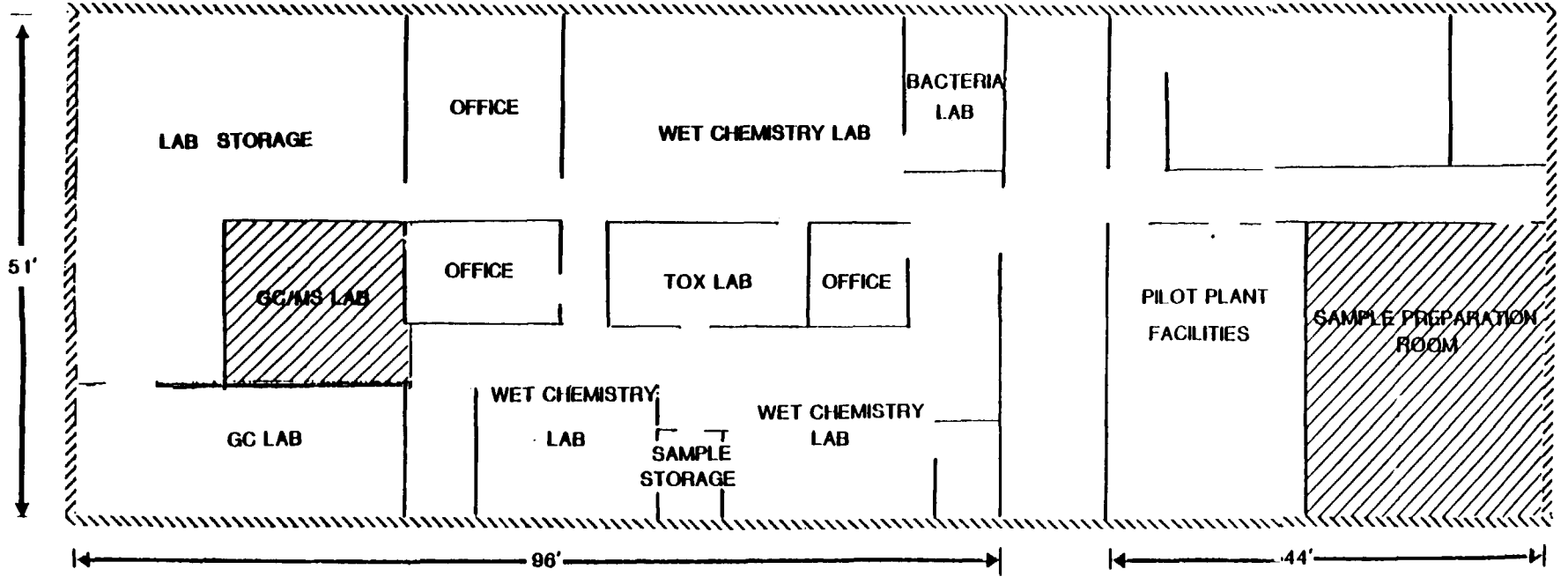

LAB STORAGE
OFFICE
WET CHEMISTRY LAB
BACTERIA LAB
51'
GC/MS LAB
OFFICE
TOX LAB
OFFICE
PILOT PLANT FACILITIES
SAMPLE PREPARATION ROOM
GC LAB
WET CHEMISTRY LAB
SAMPLE STORAGE
WET CHEMISTRY LAB
96'
44'

FIGURE C-3-1

FIGURE C-3-2

LABORATORY ORGANIZATION CHART

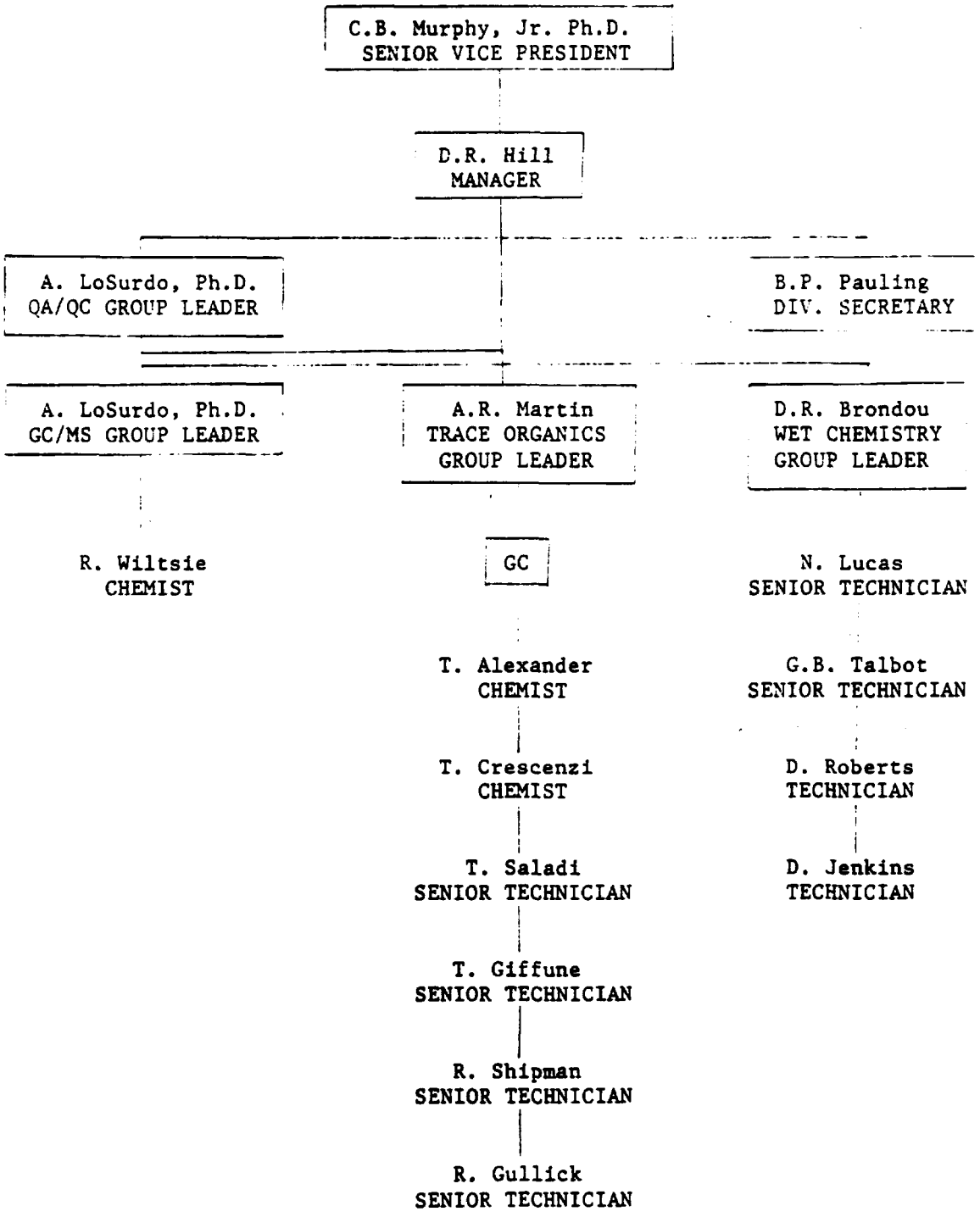


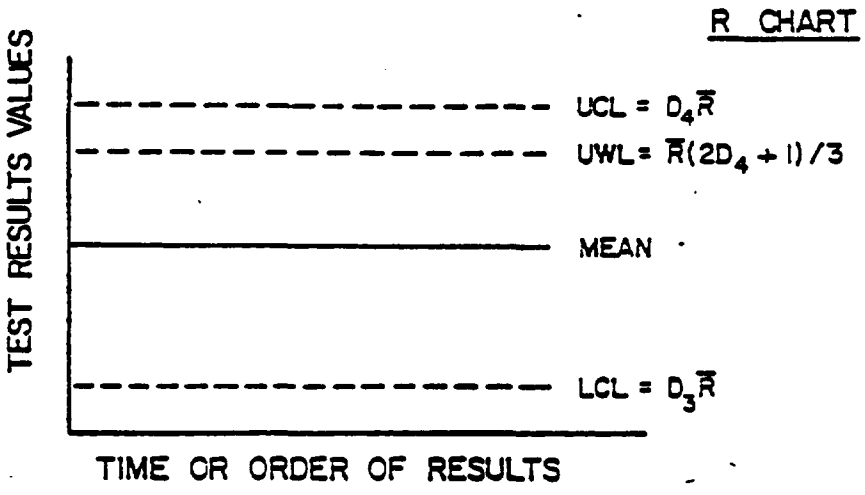
FIGURE C-3-3

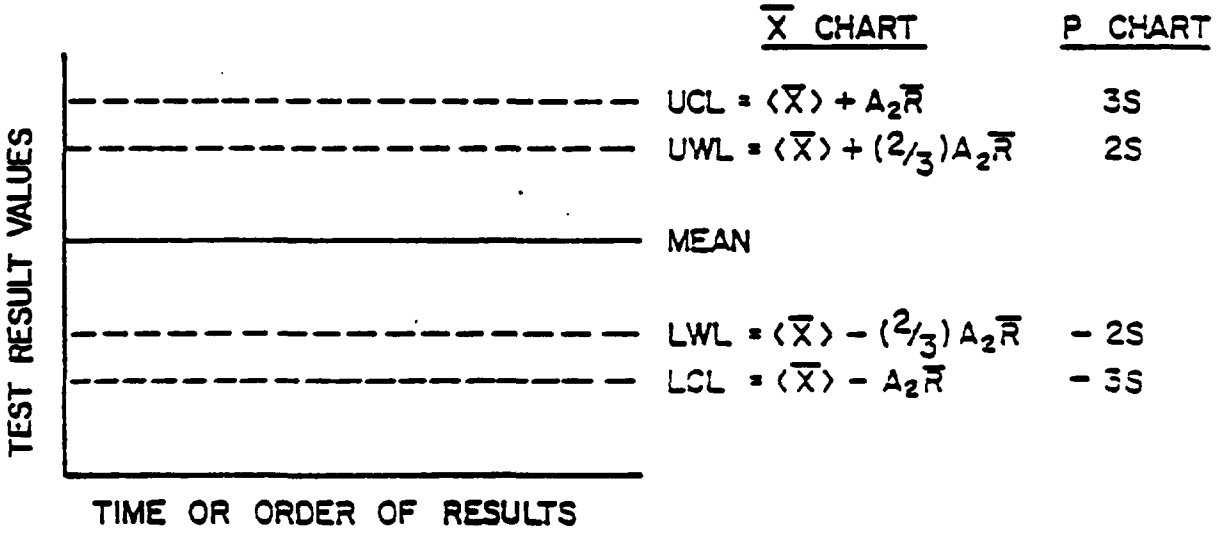
CHAIN OF CUSTODY RECORD

SURVEY				SAMPLERS: (Signature)					
STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water (Comp. / Grab)	SAMPLE TYPE: Air	SEC. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED	
Relinquished by: (Signature)				Received by: (Signature)				Date/Time	
Relinquished by: (Signature)				Received by: (Signature)				Date/Time	
Relinquished by: (Signature)				Received by: (Signature)				Date/Time	
Relinquished by: (Signature)				Received by Mobile Laboratory for field analysis: (Signature)				Date/Time	
Dispatched by: (Signature)		Date/Time		Received for Laboratory by:				Date/Time	
Method of Shipment:									

FIGURE C-3-4

ESSENTIALS OF CONTROL CHARTS





ATTACHMENT C-4

RESUMES

DAVID R. HILL
MANAGER OF ANALYTICAL SERVICES

BACKGROUND

Mr. Hill joined O'Brien & Gere in 1971 and was appointed Manager of Analytical Services in 1981. He provides technical expertise and management of projects involving the following areas: hazardous waste analytical protocol development; chain of custody; QA/QC; analysis of water and wastewater; and gas chromatographic analysis of chlorinated hydrocarbons.

EDUCATION

Clarkson College of Technology, 1971, BS/Chemistry
Syracuse University, 1979, MS/Sanitary Science

PROFESSIONAL AFFILIATIONS

American Chemical Society
American Water Works Association
Member, Subcommittee on Phosphorus, Standard Methods for the Examination of Water and Wastewater, 15 edition (in preparation).

EXPERIENCE

Responsible for financial and market efforts of analytical services; also for the supervision, coordination, scheduling and evaluation of data analyzed by a 16 member staff.

Mr. Hill's experience with the Firm also includes the supervision of projects dealing with the following: Organic characterization of a chemical waste pond for a chemical manufacturer; a groundwater monitoring program for the analysis of hazardous wastes, volatile halogenated organics and aromatic hydrocarbons for a major manufacturer; analytical programs to support RCRA compliance; provision of analytical support for the identification of hazardous waste material for a metal manufacturer; and analysis of water, sediment and biological tissue samples for PCBs.

Supervision of analytical services which include the following capabilities; gas chromatography/mass spectroscopy, automated instrumentation, microbiology, virology, atomic absorption, wet chemistry, specific ion electrode chemistry, NMR, ESR, quality control, methods development, infrared and ultraviolet spectroscopy, Xray crystallography, electron microscopy; interpretation and review of analytical results; oversee a coop program with area community colleges; oversee analysis of drinking water, wastewater, and industrial effluents; assist in the design of a computerbased laboratory data system; quantitative and qualitative analysis of chlorinated hydrocarbons; fingerprinting organics via liquid partioning and gas chromatographic analysis; proficient in analytical techniques for wastewater analysis.

In addition, he has directed the following specific projects:

Department of Environmental Conservation, Syracuse, NY - Characterization of hazardous waste at fire demolition site. Immediate response needed due to public health concern.

Department of Environmental Conservation, Waterford Pilot Plant, Albany, NY - Analysis of water samples from the pilot plant for the treatment of halogenated organics, including PCBs, using granular activated carbon, macroreticular resins and filtration.

Monsanto Corporation - Collaborative testing program for evaluation of methods to analyze purgeable halogenated aliphatic and aromatic hydrocarbons. Methods 601, 602, 501.1 and 501.2.

Southwest Research Institute - Collaborative testing program for evaluation of methods for phthalate ester compounds. Method 606.

Monroe County, NY Combined sewer overflow characterization analysis; Pilot Plant Demonstration Program analysis.

Onondaga County, NY - Combined sewer overflow characterization analysis; Onondaga Lake and Creek Monitoring analysis; Onondaga County Industrial Waste Study Analysis.

Poughkeepsie, NY - Analytical portion of current process optimization study for removal of trihalomethanes.

Syracuse University, Syracuse, NY - Cazenovia Lake Study - Nutrient budget study and assessment of phosphorus release from the lake sediments.

PUBLICATIONS

"Characterization of Industrial Wastes by Evaluating BOD, COD and TOC." Hill, David R., Spiegel, Stuart J., Journal Water Pollution Control Federation, Vol. 52II, November 1980.

"Loss of Polychlorinated Biphenyl Homologues During Chromium Trioxide Extraction of Fish Tissue." Hill, David R., Spiegel, Stuart J., Szelewski, Michael J., Tifft, Edwin C., Jr., Analytical Chemistry, 51:14, December 1979.

"BOD, TOC and COD in Industrial Wastes." Hill, David R., Spiegel, Stuart J., Industrial Wastes, 21, November/December 1979.

MANUSCRIPTS

"Evaluation of New York Bight Lobsters for PCBs, DDT, Petroleum Hydrocarbons, Mercury and Cadmium." Hill, David R., Roberts, Alan E., Tifft, Edwin C., Jr., 1982.

"Studies of Certain Inorganic Nutrients in Cazenovia Lake. (Thesis)" Hill, David R., Syracuse University, December 1979.

"A General Nutrient Evaluation of Cazenovia Lake." Hill, David R., 1977, (Lake Report 2), p. 80-88, Effler, S.W., Rand, M.E. (eds) Cazenovia Lake Study, 1 - Initiation Department of Civil Engineering, Syracuse University.

ANTONIO LO SURDO, Ph.D.
SENIOR CHEMIST - QA/QC
GROUP LEADER

BACKGROUND

Dr. LoSurdo joined O'Brien & Gere in 1982 after working for 17 years in the field of physical/analytical chemistry. Fields of special competence include physical/analytical chemistry; thermodynamics; electrochemistry; instrumental methods of chemical analysis; inorganic and organic chemistry; analysis of water and wastewater; gas chromatographic analysis of pesticides, herbicides and PCBs; research and development; model calculations; interpretation of results; and technical writing.

EDUCATION

Syracuse University, 1965, BA/Chemistry
Syracuse University, 1970, Ph.D./Physical Chemistry

PROFESSIONAL AFFILIATIONS

American Chemical Society
American Association for the Advancement of Sciences
Sigma Xi
New York Academy of Sciences

EXPERIENCE

Dr. LoSurdo brings exceptional experience and expertise to O'Brien & Gere. He has 17 years of experience in research and teaching of physical chemistry. He has authored or co-authored some 36 publications on various topics.

In the environmental field, he directed a chemistry laboratory which provided sampling and analysis services for water, wastewater, solid waste and hazardous waste. Typical analytical programs included the measurement of trace metals, trace organics, herbicides and perticides, conventional pollutants, microbiology, and the measurement of PCBs in oils, sludges and water collected under compliance programs.

He is responsible for the performance and quality control of all test protocols using conventional analytical and modern instrumentation techniques, and participated in the development of solutions to water, industrial wastewater, municipal wastewater and hazardous waste treatment problems as part of project teams.

PUBLICATIONS

H.E. Wirth and A. LoSurdo, "Volume Changes on Mixing Electrolyte Solutions", Report to the Office of Saline Water, 1966. Available from U.S. Govt. Printing Office, Division of Public Documents, Washington, D.C. 20402.

H.E. Wirth and A. LoSurdo, "Temperature Dependence of Volume Changes on Mixing Electrolyte Solutions", J. Chem. Eng. Data 13(2): 226-231 (1968).

H.E. Wirth and A. LoSurdo, "Solubility of Benzene in Concentrated Aqueous Solutions of Tetraalkylammonium Bromides", J. Phys. Chem., 72(2): 751-752 (1968).

A. LoSurdo and H.E. Wirth, "Proton Magnetic Resonance in Concentrated Aqueous Solutions of Tetraalkylammonium Bromides and Inorganic Halides at 25 and 65o", J. Phys. Chem., 76(1): 130-132 (1972).

A. LoSurdo and H.E. Wirth, "The Temperature Dependence of the Apparent and Partial Molal Volumes of Concentrated Aqueous Electrolyte Solutions of Tetraalkylammonium Bromides, Cetyltrimethylammonium Bromide and Ammonium and Lithium Bromides", J. Phys. Chem., 76(9): 1333-1338 (1972).

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W.-Y. Wen, A. LoSurdo, C. Jolicoeur and J. Boileau, "Aqueous Solutions of Azoniaspiroalkane Halides. II. Apparent Molal Volumes and Apparent Molal Heat Capacities", J. Phys. Chem., 80(5): 466-470 (1976).

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F.J. Millero, A. LoSurdo and D. Means, "The Denisty and Speed of Sound of Ocra Basin Brines", Abstract, 1977 Fall Meeting, American Geophysical Union, San Francisco, December.

F.J. Millero, A. LoSurdo, and C. Shin, "The Apparent Molal Volumes and Adiabatic Compressibilities of Aqueous Amino Acids at 25°C", J. Phys. Chem., 82(7): 784-792 (1978).

A. LoSurdo, C. Shin, and F.J. Millero, "The Apparent Molal Volume and Adiabatic Compressibility of Some Organic Solutes in Water at 25°C", J. Chem. Eng. Data, 23(3): 197-201 (1978).

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A. LoSurdo and F.J. Millero, "The Effect of Pressure on the Ionization of Phosphoric Acid from Volume and Compressibility Data at 25°C", Abstract, Gordon Research Conference on Water and Aqueous Solutions, Chemistry and Physics of, Plymouth, New Hampshire, July 31-August 4, 1978.

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F.J. Millero, A. LoSurdo, P. Chetirkin, and N.L. Guinasso, Jr., "The Density and Speed of Sound of Orca Basin Waters", Limnol. Oceanogr., 24(2): 218-225 (1979).

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A. LoSurdo, "Relative Viscosity and Viscosity Coefficients of Aqueous Azoniaspiroalkane Bromides at 25oC", J. Soln. Chem., 8(6): 439-447 (1979).

A. LoSurdo, W.-Y. Wen, and C. Jolicoeur, "Aqueous Solutions of Azoniaspiroalkane Halides. VI. Apparent Molal Volumes and Apparent Molal Heat Capacities of Chlorides and Iodides", J. Soln. Chem., 8(6): 449-450 (1979).

A. LoSurdo and F.J. Millero, "The Volume and Compressibility Change for the Formation of Transition Metal Sulfate Ion Pairs at 25°C", J. Soln. Chem., 9(3): 163-181 (1980).

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A. LoSurdo, Book Review on "WATER, A Comprehensive Treatise", Vol. (6), F. Franks (Editor), Bulletin of Marine Science, 30(3): 747 (1980).

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A. LoSurdo, F. Vinokurova and F.J. Millero, "The Molal Volume and Compressibility of Aqueous Carbonate Solutions from 0 to 1 m and from 0 to 50°C", J. Solution Chem., in preparation.

A. LoSurdo, P. Chetirkin, C. Campillo and F.J. Millero, "The Molal Volume and Compressibility of $CaCl_2$, $SrCl_2$ and $BaCl_2$ Aqueous Solutions from 0 to 1 m and 0 to 45°C", J. Solution Chem., in preparation.

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A. LoSurdo and H.E. Wirth, "Solubility of Thallus Chloride in Aqueous Electrolyte Solutions", J. Phys. Chem., to be submitted.

DONALD R. BRONDOU
SENIOR CHEMIST

BACKGROUND

Mr. Brondou joined O'Brien & Gere in 1969 as a field technician. He was Quality Control Officer for the entire laboratory including the chemistry, biology and gas chromatography groups. He became a Senior Chemist in 1980 and presently serves as the laboratory's Chemistry Group Leader.

EDUCATION

State University College of New York at Morrisville, 1969, AS/Water Resource Management

EXPERIENCE

Laboratory: Familiarity with all chemical and instrumental laboratory analyses; advisor to student employees in cooperative education program; assistant to laboratory supervisor in scheduling of analyses, review of analytical results, handling of accounting and operational functions of the lab; responsible for review and reporting all analytical data for Onondaga County Industrial Waste Monitoring Program.

Onondaga Lake Study, Syracuse, NY - Operation of sampling equipment and analysis of samples.

City of Norwich, NY - Operation and maintenance of a carbon filtration pilot plant system.

J. P. Lewis Paper Co., Beaver Falls, NY - Operation and maintenance of pilot plant; analysis of samples for BOD, COD and solids removal.

City of Morganton, NC - Oversight of treatment plant waste characterization program to determine the plant's efficiency.

USV Laboratories - Hazardous waste sampling and analytical services associated with RCRA waste streams.

A. ROBERT MARTIN
TRACE ORGANICS
GROUP LEADER

BACKGROUND

Mr. Martin joined O'Brien & Gere in 1982 after working for seven years in the field of analytical chemistry. His area of special expertise is the gas chromatographic analysis of environmental matrices and industrial waste matrices for volatile and semi-volatile organic compounds.

EDUCATION

Northeastern University, 1977, BA/Biology

PAST EXPERIENCE

Prior to joining O'Brien & Gere Mr. Martin directed a water chemistry laboratory whose capabilities included trace metals, trace organics, conventional pollutants and microbiology. Typical analytical programs included the measurement of waste treatment performance, the determination of toxic shock in waste treatment plants and the determination of the degree of lake deterioration.

Between 1978 and 1980 Mr. Martin directed a gas chromatography laboratory. Under his direction the laboratory expanded from three to seven instruments and included a staff of six chemists. Typical programs included the monitoring of sediment and water samples from across the country for organochlorine pesticides and triazine herbicides, the measurement of PCBs in oils, sludges, soils and water collected under PCB compliance programs, and the validation of analytical methods for the measurement of PCBs in transformer oil, hydraulic fluids, capacitor fluids and waste oils sponsored by EPA Environmental Monitoring and Support Laboratories in Cincinnati, Ohio.

CURRENT EXPERIENCE

As manager of the trace organics laboratory, Mr. Martin's responsibilities include the supervision of seven chemists and technicians, the coordination of analytical activities, the development of analytical methodologies, and the presentation of results.

The following client projects are either ongoing or have passed through the laboratory under Mr. Martin's direction.

Halogenated Volatile Organics - For one client, the laboratory will perform over 4,000 tests this year for vinyl chloride, trichloroethylene and 26 other organics. Samples are collected every day from activated carbon treatment systems, air stripping systems and groundwater monitoring wells.

Appendix D

APPENDIX D

SAMPLING PLAN

GRANITE CITY SITE

GRANITE CITY, ILLINOIS

Submitted By:

O'BRIEN & GERE ENGINEERS, INC.
1304 BUCKLEY ROAD
SYRACUSE, NEW YORK 13221

TABLE OF CONTENTS

OBJECTIVE

The objective of this sampling plan is to provide a document outlining sampling locations, procedures and practices that will be used in the NL Industries - Granite City Site Remedial Investigation sampling program.

TYPES OF SAMPLES

During the sampling program, a variety of general sample types will be collected. These are listed below:

- Waste slag and other waste materials associated with lead smelting;
- Groundwater;
- Surface soils off the site;
- Stormwater runoff sediments;
- Stormwater runoff; and
- Drummed materials.

At many sites, areal soil composites will be prepared. Areal composites are used as a screening device to allow initial assessments of broad areas for a range of contaminants. Compositing procedures are discussed below. No time-composited samples are contemplated at this time.

GENERAL SAMPLING LOCATIONS AND NUMBERS

Sample Locations

The locations of the existing wells and slag pile are shown in Figure D-1. The soil sampling grid is illustrated in Figure D-2. The off-site removal areas to be sampled are presented in Figures D-5 and D-6. The locations of the soil samples are listed in Table D-1. Samples to be collected and analyzed are identified in Table D-2. The sample team leader will be responsible for determining the exact sampling locations of the soil and slag samples and which drums are to be sampled. The sample team leader will also be responsible for recording each location in the field sampling notebook using the form presented as Figure D-3. Each location will be described in the field sampling notebook with a sketch that includes landmarks. All sampling locations will be photographed.

Sample Numbering System

A sample numbering system will be used to identify each sample taken during the remedial investigation sampling program. This numbering system will provide a tracking procedure to allow retrieval of information regarding a particular sample and to assure that each sample is uniquely numbered. The numbering system will consist of a sample

type identifier and one ID code number. Three other distinct ID code numbers are available if necessary. The sample type identifier may contain up to three digits, whereas the ID code numbers may consist of up to four digits. Table D-3 presents the sample numbering system. As indicated in the table, each sample type (i.e., waste slag, upper strata, SLLR pile, groundwater, soil core, stormwater sediment, stormwater runoff, and drummed materials) will be identified by a unique number. The first ID number will correspond to the appropriate location identifier for each sample.

SAMPLING EQUIPMENT AND SAMPLING PROCEDURES

Sample containers and preservatives are described in a later section. Containers for split samples for USEPA or IEPA will be provided by the respective regulatory agency.

Slag Sampling

The slag generated during the smelting operations exists primarily as objects weighing on the order of 500 pounds. A composite slag sample will be collected from each of the four quadrants within the slag pile. Geologic tools will be used to remove four pieces of slag of approximately 100 grams from each of four pieces of slag within a quadrant of the slag pile. The 16 subsamples will be transported to the laboratory in polyethylene containers identical to those used for soil samples. At the laboratory the 16 subsamples will be combined and crushed enough to pass through a 9.5 mm standard sieve. The composite sample will be thoroughly mixed to create a composite sample of the slag. Samples of this material will be subjected to digestion and analyses for recoverable metals listed in Table D-2 in accordance with the procedures described previously in the QAPP.

Slag Pile Upper Strata

The upper strata of the slag pile is composed of a mixture of shredded battery cases, slag, and dust. Ten samples of the upper strata will be collected with shovels to provide information on materials which are exposed to the atmosphere. Sufficient samples will be collected to fill a one-gallon paint pail. The contents of the paint pail will be poured on-site through a 9.5 mm standard sieve with the material passing the sieve being retained for analyses. The particles passing through the 9.5 mm sieve will be packaged in polyethylene bags and submitted for the analyses identified in Table D-2.

St. Louis Lead Recycler's Pile

The pile of spent battery cases at St. Louis Lead Recyclers contains various types of battery cases as well as various dust particles. The sampling of this pile will be as for the upper strata at the slag pile. The sample will be classified according to size and only those particles passing a 9.5 mm sieve analyzed for the constituents identified in Table D-2.

Groundwater Sampling Procedures

The twelve groundwater monitoring wells shown in Figure 1 will each be sampled two times. During the first round of sample collection (first quarter), all groundwater samples will be analyzed for the parameters noted in Table D-2. Upon collection, each sample will be filtered through a 0.45 micron filter and acidified to a pH of 2 or less with nitric acid. Three (i.e., 25% of the total number of first quarter ground water samples) additional samples will be obtained for analysis for unfiltered lead, as indicated in Table D-2. These samples will not be filtered, but will be acidified upon collection to a pH of 2 or less with nitric acid and analyzed for total lead. During the second round of groundwater sampling (second quarter), the samples will be filtered and acidified upon collection, and analyzed for those parameters found to be present in significant concentrations in the first quarter groundwater samples.

Based on available data, Well C107S has the highest groundwater elevation and appears to have groundwater quality representative of background conditions. Therefore, Well C107S is assumed to be the background well. Monitoring well depths, are as follows (note: S indicates shallow and D designates deep):

Well	Depth from Grade (ft)
C101	25
C102	25
C103	25
C104	27
C105S	26
C105D	35.5
C106S	20.8
C106D	35.8
C107S	22
C107D	35
C108S	20
C108D	32

The following procedures will be used in sampling the groundwater monitoring wells:

1. Identify the well and record the location on the Groundwater Sampling Field Log, Figure D-4.

2. Put on a new pair of disposable gloves.

3. Cut a slit in the center of the plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned. This clean working area should be a minimum of 10 feet by 10 feet.

4. Clean all meters, tools, equipment, etc., before placing on the plastic sheet.

5. Disposable shoe covers should be placed over the samplers shoes to prevent potential contamination from dirty shoes contacting the plastic sheet. Do not kick, transfer, drop, or in any way let soils or other materials fall onto this plastic sheet unless it comes from inside the well.

6. Clean the well cap with a clean towel, and remove the well cap, and plug placing both on the plastic sheet.

7. Using an electric well probe, measure the depth to the water table and the bottom of the well. Record this information in the Groundwater Sampling Field Log.

8. Clean the well depth probe with an acetone soaked towel and rinse it with distilled water after use.

9. Compute the volume of water in the well, and record this volume on the Groundwater Sampling Field Log.

10. Attach enough polypropylene rope to a bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fill it one-half full. The purpose of this is to recover any oil film, if one is present on the water table.

11. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the groundwater from the bailer into a new glass quart container and observe its appearance. NOTE: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the groundwater only.

12. Record the physical appearance of the groundwater on the Groundwater Sampling Field Log.

13. Lower the bailer to the bottom of the well, and agitate the bailer up and down to resuspend any material settled in the well.

14. Initiate bailing the well from the well bottom making certain to keep the polypropylene rope on the plastic sheet. All groundwater should be dumped from the bailer into a graduate pail to measure the quantity of water removed from the well.

15. Continue bailing the well throughout the water column and from the bottom until 3 to 5 well volumes of groundwater have been removed, or until the well is bailed dry. If the well is bailed dry, allow sufficient time for the well to recover before proceeding with Step 14. Record this information on the Groundwater Sampling Field Log.

16. Remove the sampling bottles from their transport containers, and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples.

Arrange the sampling containers to allow for convenient filling. Filter through a 4.5 micron filter and acidify to a pH less than 2 standard units using nitric acid.

17. To minimize agitation of the water in the well, initiate sampling by lowering the bailer slowly into the well making certain to submerged it only far enough to fill it completely.

18. Record the physical appearance of the groundwater observed during sampling on the Groundwater Sampling Field Log.

19. After the last sample has been collected, record the date and time, and empty one bailer of water from the surface of the water in the well into the 200 ml beaker and measure and record the pH, conductivity and temperature of the groundwater following the procedures outlined in the equipment operation manuals. Record this information on the Groundwater Sampling Field Log. The 200 ml beaker must then be rinsed with acetone and distilled water prior to reuse.

20. Begin the Chain of Custody Record. A separate form is required for each well with the required analysis listed individually.

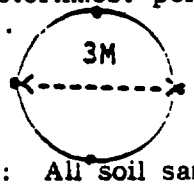
21. Replace the well plug, and lock the well protection assembly before leaving the well location.

22. Place the polypropylene rope, gloves, rags, and plastic sheeting into a plastic bag for disposal.

23. Clean the bailer by rinsing with control water, acetone mixture, and finally distilled water. Store the clean bailer in a fresh plastic bag.

Soil Lead Sampling

Locations: Samples will be obtained by compositing subsamples of approximately 40 grams each collected from four (4) equally spaced locations on the arc of a three (3) meter circle. One subsample will be collected at the northernmost point of the arc, one at the southernmost point, one at the easternmost point, and one at the westernmost point (as illustrated below).



. subsample collection point

Analytical Parameters: All soil samples will be analyzed for total lead in accordance with Table C-2 of the QAPP (Appendix C). The extraction procedure (EP) will be conducted on the off-site soil sample having the highest total lead concentration above 1000 ppm. The EP extract will be analyzed for all EP Toxic metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). The EP Toxicity test method is Method 1310 (USEPA, SW-846). The analytical procedures to be utilized in determining the metals concentrations in the extract are listed in Table C-2 of the QAPP (Appendix C).

Prior to digestion and analysis, all soil composite samples will be dried and mixed in the laboratory. The drying and mixing procedure to achieve homogeniety will be accomplished by placing the total soil composite sample in a clean glass beaker. The beaker will then be placed in a drying over at a temperature of 100°C for an 8-hour period or until the soil sample is dry. After drying, the soil will be placed in an 8-inch diameter stainless steel 16 mesh sieve. The soil will be sieved through the sieve with the aid of a glass pestle. The unsieved portion will be discarded. The sieved portion is to digested and analyzed.

Sampling Procedures: A disposable 3/4-inch diameter Lexan^{R} core capable of a vertical penetration into mineral soil three (3) inches deep, shall be used to extract the four (4) 3-inch deep core subsamples. The composite samples will consist of all four (4) subsamples placed in the same sample container. A new Lexan^{R} core will be used to collect samples at the same locations representing soils 3-inches to 6-inches below the top of the mineral soils.

The sample shall consist only of mineral soil. If sod layers are encountered, such as grass, remove the vegetative sod material by dissection using a scalpel. Discard the scalpel blade and replace with a clean blade after sampling at all four (4) subsites.

The field sampling team will be responsible for adhering to the following sample collection guidelines:

a. avoid, if possible, collecting samples that are less than 20 feet from painted surfaces;

b. locate collection sites as far as possible from vehicle activity such as streets, driveways, parking, and automobile repair areas;

c. avoid, if possible, collecting samples under or immediately adjacent to trees, shrubs, and/or structures;

d. complete site description forms (see Figure D-1);

e. a new piece of Lexan^{R} will be used for collecting subsamples at each location. The Lexan^{R} corer will be disposed of appropriately after sampling at each location; and

f. chain of custody procedures will be consistent with those outlined in the QAPP.

The soil sample containers will be sterile 27-ounce whirl-pak polyethylene containers, capable of holding 200 grams of sample. The sample containers shall be stored in a closed container to minimize atmosphere contamination. The samples are to be kept in a covered container at ambient meterological conditions.

Stormwater Sediment and Runoff Sampling

Stormwater sediment samples will be collected with disposable 3/4 inch diameter Lexan® tubing. The core will be driven three (3) inches into the sediment or to refusal whichever occurs first. A location sample will be composed of four subsamples composited in a manner similar to the soil lead samples with location radius of 0.5 meters. Stormwater sediment containers will be sterile 27-ounce whirl-pak polyethylene containers having capacity to hold 200 grams of sample. The sample containers shall be stored in a closed container to minimize atmosphere contamination. The samples are to be kept in a covered container at ambient meterological conditions. Analyses will be as presented in Table D-2.

Runoff will be collected at a catch basin during a storm event. Four samples will be collected and analyzed for the parameters noted in Table D-2. The stormwater runoff sample containers will be 500 ml plastic or glass bottles. They shall be stored in a closed container to minimize atmosphere contamination. Upon collection of the stormwater runoff samples, they shall be acidified with nitric acid to a pH of 2 standard units or less.

Drum Sampling

Drummed materials are present in the slag pile. The contents of two of the drums will be sampled in accordance with the procedures presented below, which are consistent with the procedures for sampling liquid and solid drummed wastes outlined in "Samplers and Sampling Procedures for Hazardous Waste Streams" (EPA-600/2-80-018).

General Drum Sampling

1. Identify the drum and record the location in the field sampling notebook.

2. Put on a new pair of disposable gloves.

3. Position the drum to be sampled such that the bung is up. Drums with the bung on the end should be positioned upright. Those with the bung on the side should be positioned on a side with the bung up.

4. Allow sufficient time for the drum contents to settle.

5. Loosen the bung slowly with a bung wrench, allowing any pressure to be released.

6. Remove the bung.

7. Classify the contents of the drum as liquid or solid and sample the contents accordingly, as outlined below.

Sampling Drummed Liquids Wastes

1. Sample will be obtained with a Coliwasa. Check the sample to make sure it is functioning properly.

2. Put the sampler in the open position.

3. Lower the sampler slowly into the liquid waste, assuring that the levels of the liquid inside and outside the sampler tube are approximately the same.

4. When the sampler stopper reaches the bottom of the drum, push the sampler tube downward against the stopper to close the sampler. Lock the sampler closed.

5. Withdraw the sampler slowly for the drum with one hand while wiping the sampler tube with a disposable cloth with the other hand.

6. Discharge the sample into a 2 liter widemouth glass sample bottle by slowly opening the sampler. Measure the pH and conductivity of the sample. Cap the sample bottle.

7. Begin the Chain-of-Custody Record.

8. Replace the bung.

9. Decontaminate the sampler in accordance with the General Decontamination Procedures presented below.

10. Place the gloves, rags, and other contaminated materials in a plastic bag for disposal.

Sampling Drummed Solid Wastes

1. Sample will be obtained with a sample trier.

2. Insert the trier into the waste at a 0 to 45° angle from horizontal.

3. Rotate the trier once or twice to cut a core of the waste.

4. Withdraw the trier slowly, making sure the slot is facing upward.

5. Transfer the sample into a 2 liter widemouth glass sample bottle using a brush or spatula. Cap the sample bottle.

6. Begin the Chain-of-Custody Record.

7. Replace the bung.

8. Decontaminate the sample trier in accordance with the General Decontamination Procedures presented below.

9. Place the gloves, rags, and other contaminated materials in a plastic bag for disposal.

Field Blanks

Field Blanks for sediment and soil samples will consist of analytical grade diatomaceous earth. For water samples, ultrapure distilled/deionized water will be used. The field blank sample will be placed into the appropriate sampling equipment, removed from the equipment, and then placed into sampling containers.

Duplicate Samples

Duplicate samples are defined as two distinct samples taken from the same location at similar times using identical sampling equipment that has been decontaminated in a similar manner. Duplicate samples of wastes and soil cores will consist of a given core homogenized, divided equally and submitted for analysis as two distinct samples.

Split Samples

A number of samples may be split with a representative of the USEPA and IEPA for analysis. Split samples are defined as one distinct sample that is divided equally and sent to two different laboratories for analysis. Soils will be field homogenized in a clean aluminum pan prior to splitting. Water sample splits will be duplicates.

General Decontamination Procedures

Decontamination of sampling equipment after well installation and waste sampling will be as follows:

1. Wash sampling equipment in a bucket or tub filled between 50 and 75 percent with a TSP solution (2 lbs of TSP per 10 gallons of clean water). Completely brush the entire exterior surface of the article undergoing decontamination. Wash interior wetted surfaces as required. Drilling equipment, augers and split spoon samplers can be decontaminated by steam cleaning using clean water.

2. Rinse all sampling equipment in a bucket or tub filled between 50 and 75 percent with Granite City water supply water. Completely brush the entire exterior surface of the article undergoing decontamination. Rinse interior wetted surfaces as required.

3. Collect all wash and rinse water in a properly marked and sealed container. Wash and rinse water will be analyzed relative to its hazardous waste characteristics and disposed of in accordance with all applicable state and federal regulations.

Equipment used in obtaining soil, groundwater, stormwater sediment, and stormwater runoff samples will be decontaminated as follows:

1. Thoroughly wash and rinse the sampling equipment in hot tap water and then rinse the equipment with tap water after sampling at each location. A suitable brush or Kimwipes may be necessary for adequate cleaning.

DOCUMENTATION

Photographs

Polaroid photographs will be taken to illustrate sampling locations. The photographs will show the surrounding area and reference objects which help to locate sampling sites. Sample site photographs will be attached to the appropriate sampling site description form.

Field Notebooks

Field notebooks will provide the means of recording data on collecting activities performed at a site. As such, entries will be described in as much detail as possible so that anyone going to the site could reconstruct a particular situation without reliance on memory.

Field notebooks will be composed of a Figure D-3 completed for each sampling location. Notebooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each notebook will be identified by the project-specific number.

The cover of each notebook will contain:

Person or Organization to whom the book is assigned.
Book Number
Project Name
Start Date
End Date

Entries into the notebook will contain a variety of information. At the beginning of each entry, the date, start time, weather, all field personnel present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, all field sampling team personnel and the purpose of their visit will be recorded in the field notebook.

All measurements made and samples collected will be recorded. All entries will be made in ink with no erasures allowed. If an incorrect entry is made, it will be crossed out with a single strike mark. Wherever a sample is collected or a measurement is made, a detailed description of the location of the station shall be recorded. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the procedures documented in this plan. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. In addition, the cooler number into which the sample is placed in the field will be recorded. Sample numbers will be assigned prior to going onsite. Significant field notebook entries (samples collected, significant observations) shall be countersigned by another member of the project team.

CONTROL OF CONTAMINATED SAMPLING MATERIALS

Disposable sampling and safety equipment and excess samples may be generated during sampling operations. These materials will be placed in containers (separate containers for solids, decontamination liquids, debris, and disposable equipment). Decontamination liquids should also be separated based on those containing detergents and those containing only rinses. The containers will be sealed, labelled and properly stored in a secure area for legal disposal.

SAMPLE CONTROL

Serialized sample labels will be used to label each sample for analysis. Chain-of-custody records will be completed for all samples according to EPA requirements and procedures set forth in NEIC Policies and Procedures (EPA-330/9-78-001-R, Revised June 1985). Custody seals will be placed on all shipping coolers containing samples.

SAMPLE CONTAINERS AND SAMPLE PRESERVATION

The soil, sediment, and slag samples will be contained in sealable, polyethylene containers having a capacity to hold 200 grams. The samples will be kept in a covered container at ambient meterological conditions. The sample containers will be sterile, 27 ounce whirl-pak polyethylene containers. They shall be stored and kept in a closed container to minimize atmospheric contamination.

The groundwater and stormwater runoff samples will be contained in capped plastic or glass bottles having a capacity of 500 ml. Upon collection, the groundwater samples will be filtered in the field through 0.45 micron filters and acidified with concentrated nitric acid to a pH of 2 or less. During the first round of groundwater sample collection, the three additional samples collected (25% of total groundwater samples) will not be filtered prior to acidification. The stormwater runoff samples will not be filtered before being acidified with nitric acid to a pH of 2 or less. The samples will be kept in a cooled, covered container. The sample containers will be sterile. They shall be kept closed in a container to minimize atmospheric contamination.

The samples of drummed materials will be contained in 2 liter widemouth glass bottles. The samples will be kept in a covered container at ambient meterological conditions. The sample containers will be sterile. They shall be kept in a closed container to minimize atmospheric contamination.

The collected samples will be kept out of direct sunlight and, after decontamination and labeling, will be placed in coolers for shipment to the analytical laboratory.

SAMPLE SHIPPING

Samples will be packed and labelled according to DOT regulations and protocols. Samples will be shipped to the analytical laboratory so that the samples can be analyzed within allowable time limits.

TABLE D-1

SOIL SAMPLE LOCATIONS

SAMPLE NUMBER	PROPERTY
1	Venice Twp., Sector NW 24-3-10, Bl. E, Lot 22, Spruce St.
2	Venice Twp., Sector NW 24-3-10, Bl.B, Lot 22, Chestnut St.
3	Venice Twp., Sector NW 24-3-10, American Steel Foundry Co.
4	Venice Twp., Sector NE 24-3-10, Bl. 74, Niedringhaus Ave.
5	Venice Twp., Sector NE 24-3-10, Bl. 46, Lot 15, Benton St.
6	Nameoki Twp., Sector SW 18-3-9, Bl. 39, Lot 12, Edison Ave.
7	Venice Twp., Sector NW 24-3-10, Bl. H, Lot 27, Spruce St.
8	Venice Twp., Sector NW 24-3-10, American Steel Foundries
9	Venice Twp., Sector NW 24-3-10, Hubbell Metals, Inc.
10	Venice Twp., Sector NE 24-3-10, Leo Wolf, Cleveland Blvd.
11	Venice Twp., Sector NE 24-3-10, Bl. 70, Lot 8, Edison Ave.
12	Nameoki Twp., Sector NW 19-3-9, Bl. 50, Lot 8, Grand Ave.
13	Venice Twp., Sector NW 24-3-10, U.S. Army
14	Venice Twp., Sector NW 24-3-10, Commonwealth Steel
15	Venice Twp., Sector NW 24-3-10, Taracorp Inc.
16	Venice Twp., Sector NE 24-3-10, Bl. 94, Lot 4, Edison Ave.
17	Venice Twp., Sector NE 24-3-10, Bl. 79, Lot 19, Grand Ave.
18	Nameoki Twp., Sector NW 19-3-9, Bl. 80, Lot 17, Madison Ave.
19	Venice Twp., Sector SW 24-3-10, Gulf, Mobile and Ohio Railroad
20	Venice Twp., Sector SW 24-3-10, General Steel Castings Co.
21	Venice Twp., Sector SW 24-3-10, Taracorp Inc. (SLLR)
22	Venice Twp., Sector SE 24-3-10, Bl. M, Lot 18, Grand Ave.
23	Venice Twp., Sector SE 24-3-10, Bl. 90, Lot 5
24	Nameoki Twp., Sector SW 19-3-9, Granite City Steel Co.
25	Venice Twp., Sector SW 24-3-10, Chase National Bank, NY
26	Venice Twp., Sector SW 24-3-10, General Steel Castings Corp.
27	Venice Twp., Sector SE 24-3-10, Bl. E, Lot 18, State St.
28	Venice Twp., Sector SE 24-3-10, Bl. F, Lot 9, Madison Ave.
29	Venice Twp., Sector SE 24-3-10, Bl. I, Lot 23, 14th St.
30	Nameoki Twp., Sector SW 19-3-9, Bl. 1, Lot 404, 14th St.

SAMPLE NUMBER	PROPERTY
31	Venice Twp., Sector NW 25-3-10, Bl. 20, Lot 15, Meridocia Ave.
32	Venice Twp., Sector NW 25-3-10, Lot 9
33	Venice Twp., Sector NW 25-3-10, Bl. 19, Lot 31, State St.
34	Venice Twp., Sector NE 25-3-10, Bl. B, Lot 1, 12th St. & Iowa St.
35	Venice Twp., Sector NE 25-3-10, Bl. 11, Lot 9, Greenwood St.
36	Nameoki Twp., Sector SW 19-3-9, Bl. 4, Lot 121, 12th St.
37	Venice Twp., Sector NE 35-3-10, Alley in 200 block between Weber St. and Granville St.
38	Venice Twp., Sector NE 35-3-10, Alley South of Broadway in 600 block near St. Mark's Church.
39	Venice Twp., Sector NE 35-3-10, Alley in 700 block of Broadway.
40	Venice Twp., Sector NE 35-3-10, Alley between Abbott St. and Hampden St. and between 24th St. and Penn R.R.
41	Venice Twp., Sector NW 35-3-10, Slough Rd.
42	Venice Twp., Sector SE 26-3-10, Alley between Oriole St. and Klein Ave. approximately 15 ft. north of Brown St.
43	Venice Twp., Sector NE 36-3-10, Large lot on Terry St.
44-47	Venice Twp., Sector NE 36-3-10, Ravine between Terry St. and Watson St. within one block west of Roosevelt Dr.

TABLE D-2

REMEDIAL INVESTIGATION

ANALYTICAL PROGRAM

JUNE 1986 REVISION

	Sample Site	#	Field Sieve[1]	Lab Sieve[2]	Digest	Ext.	Filt.	pH	Cond.	Pb	Cd	Cr	Ba	As	Hg	Se	Ag	Sb	Cu	Fe	Mn	Ni	Zn	SO_4	TDS
3a																									
	Slag	4	--	4	4	2	--	--	--	4	4	4	4	4	4	4	4	4	4	4	4	4	4	--	--
	Upper Strata	10	10	--	10	5	--	--	--	10	10	10	10	10	10	10	10	10	10	10	10	10	10	--	--
	SLLR Pile	2	2	--	2	1	--	--	--	2	2	2	2	2	2	2	2	2	2	2	2	2	2	--	--
	Drummed Material	2	--	--	*	1	--	*	*	2	2	2	2	2	2	2	2	2	2	2	2	2	2	--	--
3b																									
	Wells Quarter - 1	15	--	--	3	--	12	15	15	15	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	Wells Quarter - 2	15	--	--	3	--	12	15	15	15	12	12	12	12	12	12	12	**	**	**	**	**	**	**	**
3c																									
	Soils Grid	72	--	72	72	--	--	--	--	72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Off-Site Removal Areas	11	--	11	11	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3d																									
	Deposition	4	--	--	4	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Runoff	4	--	--	4	--	--	4	4	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

1 Field sieving indicates that samples will be sieved in the field through a 9.5 mm standard sieve. That portion passing through the sieve will be collected and submitted for analysis.

2 Lab sieving indicates that soil samples will be sieved through a 16 mesh stainless steel sieve after drying (8 hours at 100°C, or until dry), prior to analysis. Slag samples will be crushed and sieved through a 9.5 mm standard sieve in the laboratory prior to analysis.

* If the drummed materials are solid wastes, they will undergo digestion. If they are liquid wastes, they will be tested for pH and conductivity in the field.

** Second quarter groundwater samples will be analyzed for those parameters observed in significant concentrations in the first quarter groundwater analysis, as jointly agreed upon by USEPA, IEPA, and NL Industries.

The analytical program is to include one EPA Toxicity (Metals only) for Off-Site soils with highest Pb if over 1000 ppm.

In the event that activities in Task I determine that environmentally significant parameters are present, these parameters will be included in 3a and/or 3b1 above, for utilization where parameter involvement is suspected.

The preceding narrative is modified by reference to be consistent with this table. In the event of a discrepancy between this table and the RIWP, this table will be governing.

TABLE D-3

SAMPLE NUMBERING SYSTEM

Identification Type	Number	Description
Type	1	Waste Slag
	2	Upper Strata
	3	SLLR pile
	4	Groundwater
	5	Soil core - from sampling grid
	6	Soil core - from off-site removal area
	7	Stormwater sediment
	8	Stormwater runoff
	9	Drummed materials
ID 1	#	Number corresponding to horizontal location of sample;

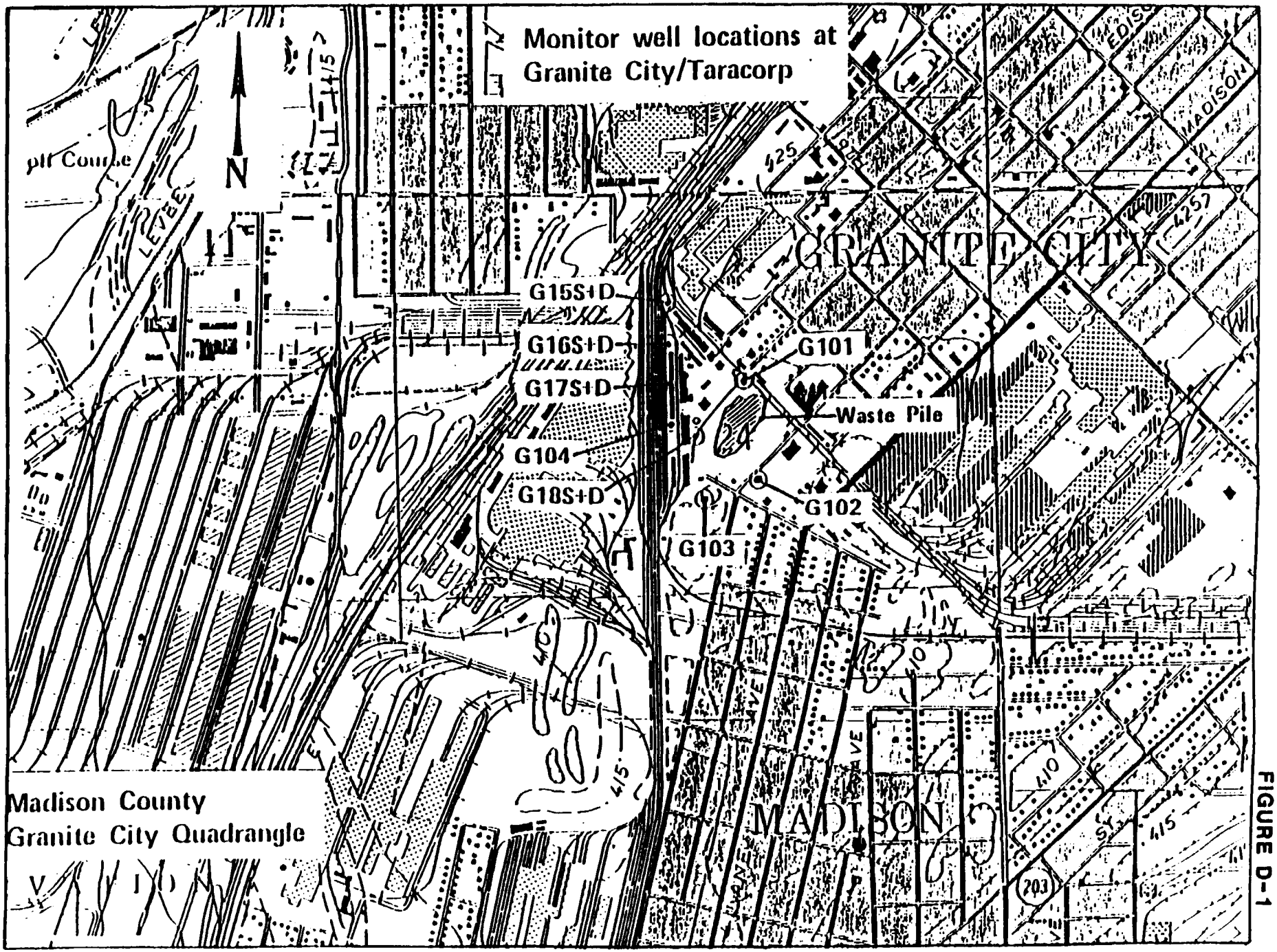

Monitor well locations at
Granite City/Taracorp
N
LEVEE
G15S+D
G16S+D
G17S+D
G104
G18S+D
G103
G101
Waste Pile
G102
GRANITE CITY
MADISON
Madison County
Granite City Quadrangle

FIGURE D-1

FIGURE D-3

SAMPLING SITE DESCRIPTION FORM

PROJECT: _____ DATE: _____

SAMPLER: _____

SITE ADDRESS: (STREET, NUMBER, COORDINATES) _____

_____

TYPE OF SITE: (RESIDENTIAL, INDUSTRIAL, ETC.) _____

PROPERTY OWNER: _____

LOCATION OF SAMPLING: (BACKYARD, PARK, ETC.) _____

SKETCH MAP OF THE SAMPLING AREA AND ATTACH IT TO THIS FORM

ATTACH POLAROID PHOTOGRAPH OF SAMPLING SITE TO THIS FORM

ADJOINING PROPERTY: (RESIDENTIAL, INDUSTRIAL, ETC.) _____

_____

GROUND SURFACE: (BARE, LAWN, ETC.) _____

_____

STRUCTURAL ODDITIES: (SWIMMING POOLS, SHEDS, ETC.) _____

_____

TYPE OF SAMPLING PERFORMED: (SOIL, DUST, ETC.) _____

_____

SAMPLE COLLECTION TAG NUMBERS: _____

_____

CONDITION OF SAMPLING SIE: (DEBRIS, RESIDUES, STANDING WATER, ETC.) _____

_____

_____

REMARKS: (INCLUDING ALL SAMPLE NUMBERS) _____

_____

_____

_____

GROUNDWATER SAMPLING FIELD LOG

FIGURE D-4

Sample Location _____ Well No. _____

Sampled By _____ Date _____ Time _____

Weather _____ Sampled with Bailer ___ Pump ___

A. Water Table

Well depth (from top of standpipe) _____ Well elevation (top of standpipe) _____

Depth to water table (from top of standpipe _____ Water table elevation _____

Length of water column (LWC) _____ (feet)

Volume of water in well - 2" diameter wells = 0.163 x (LWC) = _____ gallons
- 4" diameter wells = 0.653 x (LWC) = _____ gallons
- 6" diameter wells = 1.469 x (LWC) = _____ gallons

B. Physical Appearance At Start

Color _____ Odor _____ Turbidity _____

Was an oil film or layer apparent? _____

C. Preparation of Well for Sampling

Amount of water removed before sampling _____ gallons

Did well go dry? _____

D. Physical Appearance During Sampling

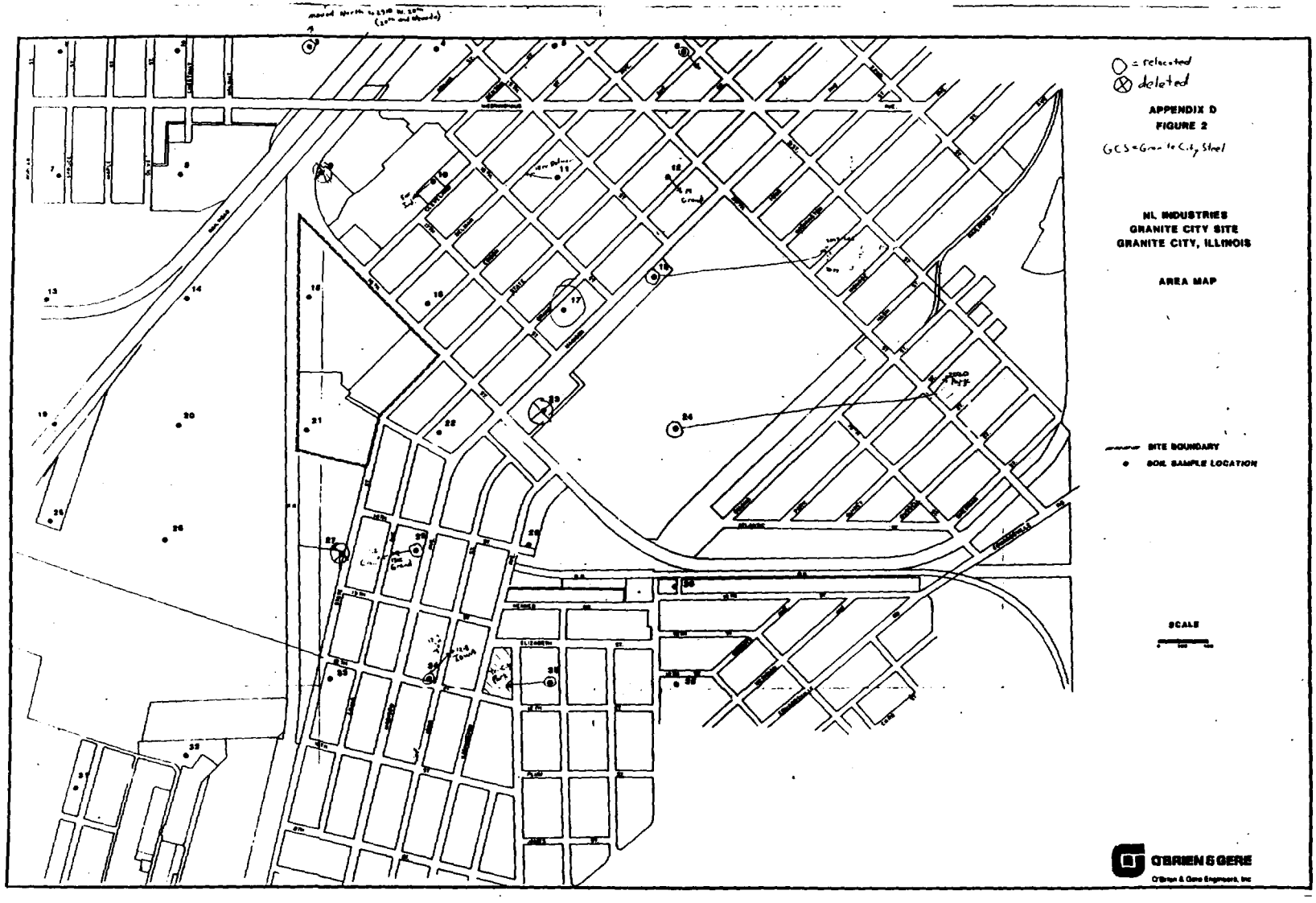
Color _____ Odor _____ Turbidity _____

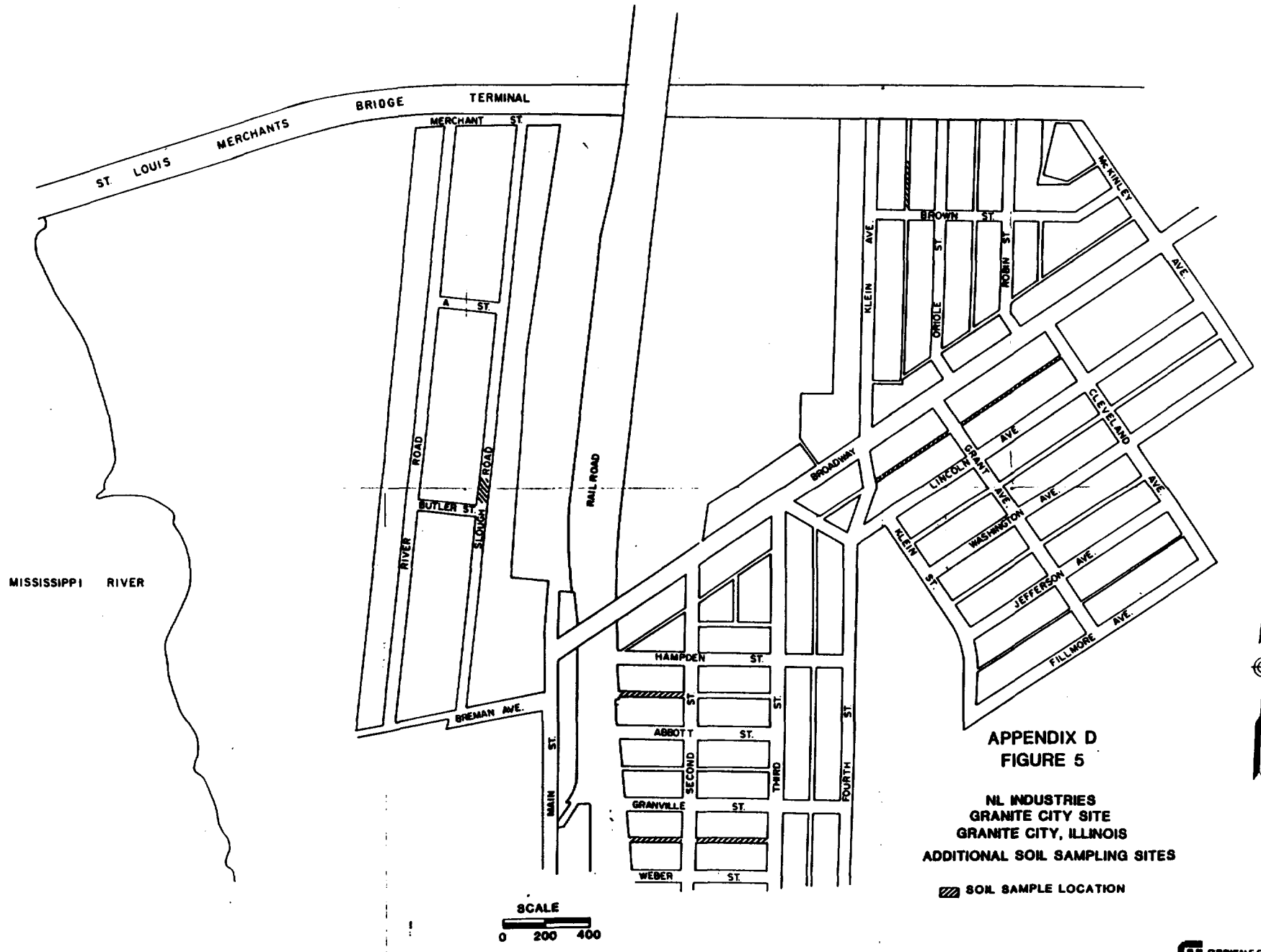
Was an oil film or layer apparent? _____

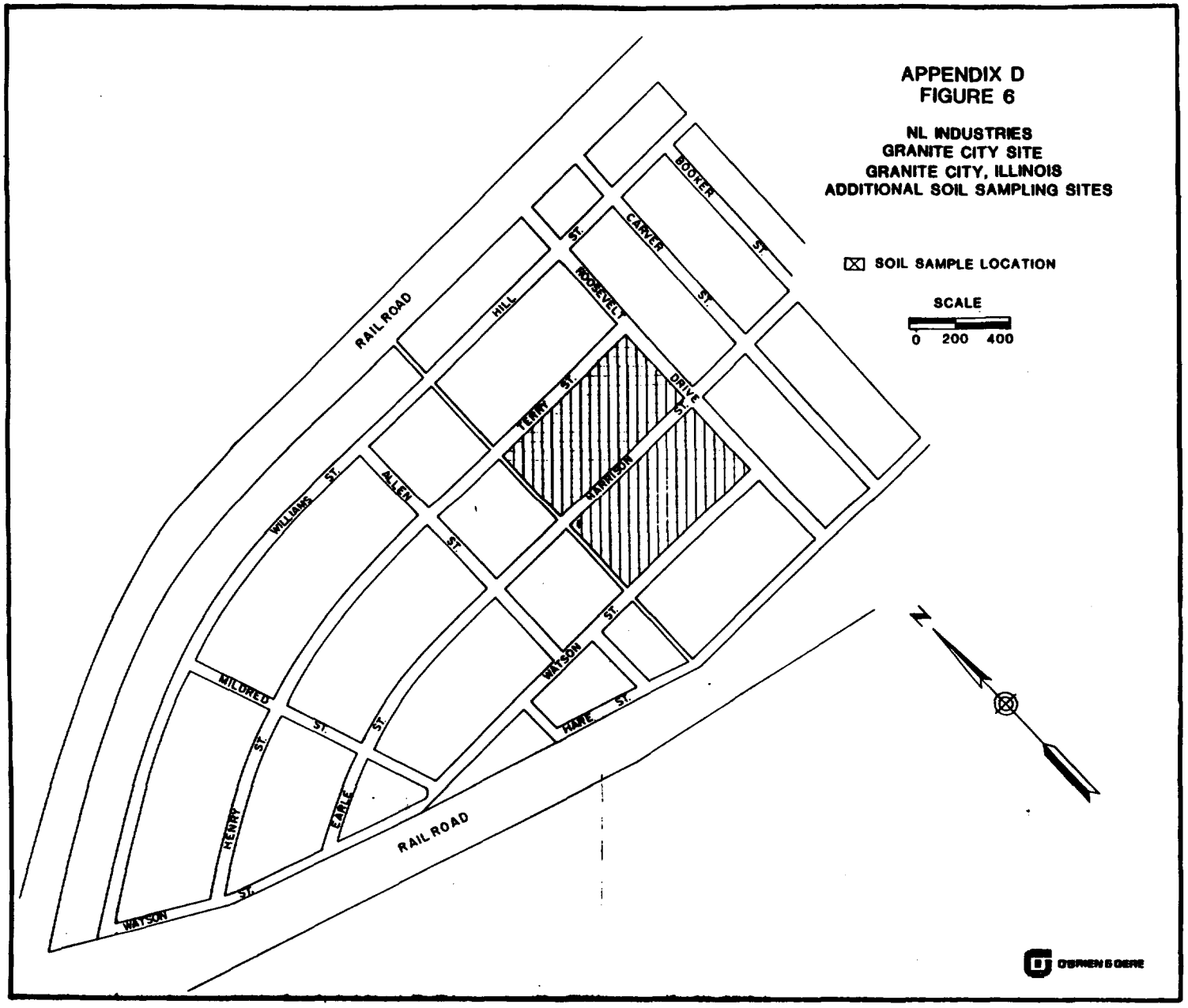
E. Well Sampling

	Analysis	Bottle No.	Special Sampling Instructions
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

F. Conductivity _____ pH _____


○ = relocated
⊗ deleted
APPENDIX D
FIGURE 2
GCS = Granite City Steel
NL INDUSTRIES
GRANITE CITY SITE
GRANITE CITY, ILLINOIS
AREA MAP
SITE BOUNDARY
SOIL SAMPLE LOCATION
SCALE
O'BRIEN & GERE
O'Brien & Gere Engineers, Inc.


ST. LOUIS MERCHANTS BRIDGE TERMINAL
MERCHANT ST.
A ST.
BUTLER ST.
RIVER ROAD
SLOUGH ROAD
RAILROAD
MISSISSIPPI RIVER
BREMAN AVE.
MAIN ST.
HAMPDEN ST.
ABBOTT ST.
GRANVILLE ST.
WEBER ST.
SECOND ST.
THIRD ST.
FOURTH ST.
KLEIN AVE.
BROWN ST.
ORIOLE ST.
ROBIN ST.
MCKINLEY AVE.
BROADWAY
LINCOLN AVE.
GRANT AVE.
CLEVELAND AVE.
WASHINGTON AVE.
KLEIN ST.
JEFFERSON AVE.
FILLMORE AVE.
N
SCALE
0 200 400
APPENDIX D
FIGURE 5
NL INDUSTRIES
GRANITE CITY SITE
GRANITE CITY, ILLINOIS
ADDITIONAL SOIL SAMPLING SITES
SOIL SAMPLE LOCATION
OBRIEN & GERE


APPENDIX D
FIGURE 6
NL INDUSTRIES
GRANITE CITY SITE
GRANITE CITY, ILLINOIS
ADDITIONAL SOIL SAMPLING SITES
SOIL SAMPLE LOCATION
SCALE
0 200 400
RAIL ROAD
HILL
ST.
ROOSEVELT
CARTER
BOOKER
YERBY
DRIVE
HAMILTON
WILLIAMS
ALLEN
MILDRED
HENRY
EARLE
WATSON
HAMIL
O'BRIEN & GERE